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EXHIBITING A VIEW OF THE

PROGRESSIVE DISCOVERIES AND IMPROVEMENTS

IN THE

SCIENCES AND THE ARTS.

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CONDUCTED BY

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34. Note, l. 5. *for* ten " open seasons," *read* two " open seasons,"
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Biographical Memoir of M. Daubenton. By Baron Cuvier.[*]

Louis Jean Marie Daubenton, member of the Senate, and of the Institute of France, professor in the Museum of Natural History and in the College of France, &c. &c., was born at Montbar, in the department of the Côte d'Or, on the 29th May 1716. His father, Jean Daubenton, was a notary in that place; his mother's name was Marie Pichenot.

He was distinguished from his childhood by the gentleness of his manners and by his ardour for labour; and he obtained from the Jesuits of Dijon, with whom he commenced his studies, all those little distinctions which are so flattering to youth, without being always the precursors of more durable success. He cherished the remembrance of them with pleasure to the end of his life, and always preserved their written testimonials.

After he had finished, under the Dominicans of the same city, what was then called a course of philosophy, his parents, who intended him for the church, and had made him assume the ecclesiastical habit after the age of twelve years, sent him to Paris to study theology; but, perhaps inspired with a presentiment of what he was one day to become, the young Daubenton devoted himself in secret to the study of medicine. He attended, at the schools of the Faculty, the lectures of Baron, Martineng, and Col de Villars,—and in that same 'Jardin des Plantes,' of which he was afterwards so great an ornament, those of Winslow, Hunauld, and Antoine de Jussieu. His father's death, which happened in 1736, leaving him free to follow his inclination openly, he took his degrees at Reims in 1740 and 1741, and returned to his native place, where he limited his ambition to the practice of his art; but his destiny reserved him for a more brilliant theatre.

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[*] Read to the Royal Institute of France.

The little town in which he was born, had also given birth to a man, whose independent fortune, personal and mental accomplishments, and violent taste for pleasure, destined him for any career but that of science, to which, however, he was incessantly drawn by that irresistible propensity, the almost unfailing indication of extraordinary talents. Buffon, for it is he of whom we speak, long uncertain as to the object to which he should apply his genius, directed his attention successively to geometry, physics, and agriculture. At length, his friend Dufay, who, during his short administration, raised the 'Jardin des Plantes' from the deplorable state into which it had sunk by the inactivity of the first physicians, who were until then superintendants of that establishment, having bestowed upon him the reversion of its charge, Buffon's choice was ultimately fixed upon natural history, and he saw opening before him that vast career which he pursued with so much glory. He at first measured its full extent; he perceived at a glance what he had to do,—what it was in his power to accomplish,—and where the aid of others would be requisite.

Overloaded from its commencement with the undigested erudition of Aldrovandus, Gesner, and Johnston, natural history was afterwards mutilated by the nomenclators. Ray, Klein, even Linnæus at that time, presented nothing but bare catalogues, written in a barbarous language, and which, with all their seeming preciseness, with all the care which their authors appeared to have taken, to place in them only what could be at all times verified by observation, still contained a multitude of errors, in the details, in the distinctive characters, and in the methodical distributions. To restore life and motion to this cold and inanimate body; to paint nature as she is, always young, always in action; to trace the wonderful harmony of all her parts; to sketch the laws by which they are bound together into a single system; to transfer to this picture all the freshness and brilliancy of the original;—such was the most difficult task of the writer who might undertake to restore to this beautiful science all the lustre which it had lost; such was that which the ardent imagination of Buffon, his lofty genius, and his intense feeling of the beauties of nature, could not fail to make him attempt. Had not truth formed the basis of his performance—had he lavished the brilliant colours of his pallet upon incorrect or unfaithful designs—had he only combined imaginary facts, he might indeed have become an elegant writer, an ingenious poet; but he would not have been a naturalist—he could not have aspired to the rank of which he was ambitious, that of being a reformer of the science. It was therefore necessary to review, to collect, to observe every thing; to compare the forms and dimensions of beings; to carry the scalpel into their interior, and lay open the most hidden parts of their organization. Buffon was sensible that his impatient spirit would not permit him to undergo those painful labours; that the very weakness of his sight would mar the hope of engaging in them with success. He sought a man who might join to the accuracy of mind and delicacy of tact necessary for such researches, sufficient modesty and devotedness, to be contented with a secondary part in appearance, to be in some measure but his eye and hand; and this man he found in Daubenton, the companion of the sports of his childhood. But he found in him more than he had sought, more even than he thought he required; and, perhaps, it was not in those things in which he asked his assistance that Daubenton was most useful to him.

In fact, it may be said that never was association better formed. There existed in the two friends, in respect both to their physical and their mental constitution, that perfect contrast which one of our most amiable writers asserts to be necessary for rendering a connection durable, and each of them seemed to have received precisely the qualities adapted to temper those of the other by opposition.

Buffon, robust in his person, imposing in his appearance, of an imperious disposition, and desirous in all things of prompt enjoyment, seemed disposed rather to guess the truth than to observe it. His imagination continually interposed itself between nature and him, and his eloquence seemed to exercise itself against his own reason, before employing itself in misleading that of others.

Daubenton, feeble in his bodily constitution, gentle in his aspect, and possessed of a moderation which he owed to nature as much as to his own wisdom, carried the most scrupulous circumspection into all his researches. He believed and affirmed only what he had seen and touched. Far from wishing to persuade by any other means than strict evidence, he carefully avoided in his conversation and writings every thing figurative, every expression that might produce deception. Possessed of immovable patience, he never intermitted his exertions; he went over the same investigation again and again, and by a method, perhaps too rare among the cultivators of real science, all the faculties of his mind seemed to unite in imposing silence upon his imagination.

Buffon thought he had only taken a laborious assistant who would level the inequalities of the road, but he found a faithful guide who pointed out to him the false paths and precipices. A hundred times did the biting smile which escaped his friend when he perceived something doubtful, bring him over from his first ideas; a hundred times did one of those words, which that friend knew so well to apply at the proper time, arrest him in his headlong progress; and the wisdom of the one thus allying itself with the energy of the other, gave to the History of Quadrupeds, the only one common to the two authors, that degree of perfection which renders it, if not the most interesting of those which enter into the great Natural History of Buffon, at least that which is the most exempt from error, and which will longest retain a classical character among naturalists.

It was, therefore, still less by what he did for him, than by what he prevented him from doing, that Daubenton was useful to Buffon, and that the latter had reason to congratulate himself for having formed such a connection.

It was about the year 1742 that he took him to Paris. The office of keeper and demonstrator of the Cabinet of Natural History was very imperfectly discharged, and the person who possessed it, a M. Noguez, having long resided in the country, its duties were performed from time to time by some of the people connected with the garden. Buffon revived it for Daubenton, and it was conferred upon him by brevet in 1745. His salary, which at first was only 500 francs, was gradually augmented to 4000. When he was only assistant in the Academy of Sciences, Buffon, who was treasurer, made him several presents. On his arrival in Paris, he also gave him an apartment. In a word, he neglected nothing to ensure him the comfort necessary for every man of letters, and for every person engaged in the cultivation of science.

Daubenton, on his part, devoted himself without intermission to the labours calculated to second the views of his benefactor, and by these very labours he erected the two principal monuments of his own glory.

One of these, although not a printed book, is not the less a very beautiful and a very instructive volume, since it is almost that of nature. I allude to the Natural History Cabinet of the 'Jardin des Plantes.' Before Daubenton's time it was a mere drug-shop, in which the products of the public courses of chemistry were collected, to be distributed to the poor who might have need of them for the cure of their diseases. In Natural History, properly so called, it only contained some shells collected by Tournefort, which had afterwards served to amuse the childhood of Louis the Fifteenth, and of which several still bore the marks of his humours.

In a very few years it entirely changed its appearance. Minerals, fruits, woods, and shells, were collected from all parts, and laid out in the best order. The means by which the various parts of organized bodies might be preserved, were made an object of discovery and improvement. The inanimate spoils of quadrupeds and birds resumed the appearances of life, and presented to the observer the minutest details of their characters, at the same time that they astonished the curious by the variety of their forms and the brilliancy of their colours.

Previous to this, the cabinets of natural productions were indeed ornamented with some riches; but those were rejected which might spoil their symmetry, or take away the appearance of decoration. A few naturalists collected the objects which might assist them in their inquiries, or give strength to their opinions; but, being limited in their fortune, they were obliged to labour a long time before they could even complete an isolated branch. Some amateurs collected series, which satisfied their tastes; but they commonly confined themselves to the most futile objects, such as were more adapted to please the sight, than to enlighten the mind. The most brilliant shells, the most variegated agates, the largest and most sparkling gems, generally formed the bases of their collections.

Daubenton, supported by Buffon, and profiting by the resources which the influence of his friend obtained for him from the government, conceived and executed a more extensive plan: he thought that none of the productions of Nature ought to be kept back from her temple; he perceived that such of these productions as we look upon as the most important, can only be well known, in so far as they are compared with all the others; that there is not even one of them which, by its numerous relations, is not more or less directly connected with the rest of nature. He therefore excluded none, and made the greatest efforts to collect all. In particular, he made an extensive collection of anatomical preparations, which long distinguished the Parisian Cabinet, and which, although less agreeable to the vulgar eye, are of the greatest utility to the man who does not confine his inquiries merely to the surface of created beings, and who strives to render natural history a philosophical science, by making it also explain the phenomena which it describes.

The study and arrangement of these treasures became to him a true passion, the only one perhaps that he had ever been remarked to possess. He shut himself up for whole days in the Cabinet. He there turned over in a thousand ways the objects which he had brought together, scrupulously examined all their parts, tried all the arrangements imaginable, until he fell upon that which neither offended the eye, nor broke asunder natural relations.

This taste for the arrangement of a cabinet revived with energy in his last years, when our victories brought a new mass of riches to the Cabinet of Natural History, and circumstances permitted the whole to assume a greater development. At the age of eighty-four, with his head bent upon his breast, his feet and hands deformed by the gout, unable to walk without the support of two persons, he was led every morning to the Cabinet, there to preside over the arrangement of the minerals, the only part that remained to him in the new organization of the establishment.

Thus it is chiefly to Daubenton that France is indebted for that temple so worthy of the goddess to whom it is consecrated, and where one knows not whether to admire most, the astonishing fecundity of nature which has produced so many different beings, or the unconquerable patience of man who has collected all these beings, named them, classed them, assigned them their relations, described their parts, and explained their properties.

The second monument which Daubenton left, was, according to his original plan, to have been a complete description of the Cabinet; but circumstances, which we shall presently point out, prevented him from extending this description beyond the quadrupeds.

This is not the place for analyzing the descriptive part of the "Histoire Naturelle *," a work as immense in its details, as it is astonishing in the boldness of its plan,—or for unfolding all that it contains of what is new and important to the naturalist. To give some idea of the work, it is only necessary to state, that it contains the description, internal as well as external, of a hundred and eighty-two species of quadrupeds, of which fifty-eight had never been dissected, and of which thirteen had not even been externally described. It contains, moreover, the external description alone of twenty-two species, of which five were previously unknown. The number of entirely new species is therefore eighteen; but the new facts relative to those which were already more or less superficially known, are innumerable. The greatest merit of the work, however, is the order and spirit with which these descriptions are given, and which is the same with regard to all the species. The author has been heard to say repeatedly, that he was the first who had established a true comparative anatomy; and the assertion was true in this respect, that all his observations being disposed according to the same plan, and their number being the same with regard to the smallest animal as with regard to the largest, it is extremely

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* The first three volumes, in quarto, appeared in 1749; the twelve following succeeded each other from that period to 1767.

easy to apprehend all the relations; that, never being restricted to any system, he has bestowed an equal attention on all the parts, and could never be tempted to neglect or disguise what was not conformable to the rules which he had established.

However natural this method must appear to persons who only judge of it by mere good sense, it is far from being very easy to follow, since it is so rare to be met with in the works of other naturalists, and there are so few among them who have been at the trouble of placing the beings which they describe, otherwise than as they are in their systems.

Daubenton's work may be considered as a rich mine, in which the naturalists and anatomists who engage in the examination of quadrupeds are obliged to dig, and from which several writers have extracted many precious articles, without acknowledgment. It is sometimes only necessary to make a table of his observations, and to place them in certain columns, in order to obtain the most striking results; and it is thus that we ought to understand Camper's expression, that *Daubenton did not know all the discoveries of which he was the author.*

He has been reproached with not having traced the table of these results himself. It was with good reason, however, that he avoided an operation which might have flattered his self-love, but which would have led him into errors. Nature had been seen by him to exhibit too many exceptions, to allow him to imagine he could establish an order in her evolutions; and his prudence has been justified, not only by the ill success of those who have been more adventurous than himself, but even by his own example; the only rule which he ventured to trace, namely, that supposed to determine the number of the cervical vertebræ, having been found, toward the end of his career, to be incorrect *.

He has been also blamed for having confined his dissections within too narrow bounds, having limited them to the description of the skeleton and viscera, without treating of the muscles, vessels, nerves, or external organs of sense; but it cannot be proved that it was possible for him to have avoided this reproach, until one has done better in the same time, and with the same means. It is certain, at least, that one of his pupils, who wished to extend his plan, did nothing but fill it up with compilations that were too often insignificant.

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* There are in general seven: the three-toed sloths, however, have nine.

As soon as his work made its appearance, Daubenton did not fail to obtain the usual recompence of all great undertakings, glory and honours, criticisms and virulence; for, in the career of science, as in all others, it is less difficult to attain glory, and even fortune, than to preserve tranquillity when one has reached them.

Reaumur at that time swayed the sceptre of natural history. No one had employed sagacity in observation with more effect, none had rendered nature more interesting, by the wisdom and the sort of detailed foresight, of which he found proofs in the history of the minutest animals. His memoirs on insects, although diffuse, were clear, elegant, and full of that interest which arises from curiosity incessantly excited by new and singular details; they had begun to diffuse a taste for the study of nature among the public at large.

It was not without some degree of chagrin, that Reaumur saw himself eclipsed by a rival, whose bold views and magnificent style excited the enthusiasm of the public, and inspired them with a sort of contempt for researches so trifling in appearance as those of which insects were the object. He evinced his bad humour in rather a sharp manner *; he was even supposed to have contributed to the publication of some critical letters †, in

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* See in the volume of *Memoires de l'Academie* for 1746, p. 483. which appeared only in 1751, a Memoir by Reaumur, on the Means of preventing the Evaporation of Spirituous Fluids, in which Objects of Natural History are preserved. He there complains violently of Daubenton's having published an extract of this memoir in the third volume of the *Histoire Naturelle*, before the memoir itself was printed.

† *Lettres à un Americain, sur l'Histoire Naturelle Generale et Particuliere de M. de Buffon*, part first, Hamburg (Paris) 1751; parts second and third, ibid. same year. It is in the ninth letter of the third part that the intention is most evinced, of defending Reaumur against Buffon. *Lettres, &c. sur l'Histoire Naturelle de M. de Buffon, et sur les Observations Microscopiques de M. Needham*, fourth part, ibid. same year. It is in the tenth letter that Daubenton is criticised with respect to the arrangement of the Royal Cabinet, and M. de Reaumur's opposed to it. Fifth part, same title, and same year. Then, *Suite des Lettres, &c. sur les Quatrième et Cinquième vol. de l'Hist. Nat. de M. Buffon, et sur le Traité des Animaux de M. l'Abbé de Condillac*, sixth part, Hamburgh, 1756. The title and date remain the same for the seventh, eighth, and ninth parts. The author, ex-oratorien, a native of Poitiers, was named the

which the eloquence of the painter of nature was opposed, by obscure metaphysical discussions, and Daubenton, in whom Reaumur saw the sole effective support of what he called the delusions of his rival, was not spared. The Academy was sometimes the scene of more direct disputes, of which we have no very distinct record, but which were so violent, that Buffon found himself obliged to employ his interest with the then favourite * to support his friend, and procure for him those higher honours which his labours had merited.

A man of merit is never without some enemies; and those who would injure, never want some protectors. The merit, on this occasion, was so much the more praiseworthy in not sinking, that it was not of a nature to strike the multitude. A modest and scrupulous observer can neither captivate the vulgar, nor even men of science unacquainted with natural history; for the learned always judge like the vulgar of such works as are not of their kind; and the number of naturalists was at that time very small. Had Daubenton's investigations appeared by themselves, they would have remained in the circle of anatomists and naturalists, who would have appreciated their true value; and their suffrage determining that of the multitude, the latter would have respected the author on trust, like those unknown gods who are so much the more revered, the more impenetrable their sanctuary is. But, marching in company with the work of his brilliant rival, Daubenton's was admitted to the toilet of the fair and the cabinet of the literary; the comparison of his measured style and cautious progress, with the lively poesy, and the venturous sallies of Buffon, could not be to his advantage; and the minute details of dimensions and descriptions into which he entered, could not, with such judges, afford any compensation for the ennui with which they were necessarily accompanied.

Thus was Daubenton celebrated in Paris, when all the naturalists of Europe received, with a gratitude mingled with admiration, the results of his immense labours; when they bestowed upon the work which contained them, and solely

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Abbé Delignac: he was closely connected with Reaumur. We have also of his, *Mémoires pour l'Histoire des Araignées Aquatiques, &c.*

* Madame de Pompadour.

because it did contain them, the names of *golden work*, and *truly classical work* *; and some of those flatterers who crawl before renown as before power, because renown is also power, induced Buffon to think that he would gain by casting off his importunate fellow labourer. The secretary of an illustrious academy was even heard afterwards to declare, that naturalists alone could regret that he followed this advice.

Buffon, therefore, published an edition of the *Histoire Naturelle* in 12mo, from which he excluded, not only the anatomical part, but also the external descriptions of the animals, which Daubenton had drawn up for the large edition; and, as nothing was substituted, the consequence was, that this work gave no idea of the forms, colours, or distinctive characters of animals; so that, were this small edition alone to resist the waste of time, as the multitude of re-impressions, that are at the present day published, might induce us to fear, there would no longer remain any means of recognising the animals of which the author meant to speak, more than we find in Pliny and Aristotle, who also neglected the particulars of the descriptions.

Buffon further resolved to appear by himself in what he subsequently published, whether on birds or on minerals. Besides the affront, Daubenton sustained by this a considerable loss. He might have commenced a prosecution, for the undertaking had been concerted in common; but, had he done so, he would have quarrelled with the Intendant of the Garden of Plants; and it would have been necessary for him to have left the cabinet which he had formed, and of which he held possession as it were for life. He therefore overlooked the affront and the loss, and continued his occupations.

The regret which was testified by all naturalists when they saw the commencement of the *History of Birds* appear unaccompanied by those careful dissections which they held in such estimation, must have contributed to console him.

He might have had still more reason to feel comforted, had not his attachment to the great man who neglected him, overcome his self-love, when he saw these first volumes, to which Gueneau de Montbeillard made no contribution, filled with inaccuracies, and destitute of all those details, which it was physically and morally impossible for Buffon to furnish.

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* See Pallas's *Glires* and Spicilegia Zoologica.

These imperfections were still more obvious in the supplements, works composed by Buffon in his old age [*], in which that great writer carried his injustice so far, as to entrust to a mere painter the part which Daubenton had so well executed in the first volumes.

Several naturalists endeavoured to supply the defect, and, among others, the celebrated Pallas took Daubenton for his model in his *Miscellanea* and *Zoological Gleanings*, as well as in his *History of the Glires;* works which ought to be considered as the true supplements of Buffon, and as the best accounts that have appeared of quadrupeds, next to his great work.

Every body knows with what success, in the departments of Fishes and Reptiles, the illustrious continuator of Buffon, De La Cepede, who was also the friend and colleague of Daubenton, and who still laments him with us, has employed in his writings the double advantage of a flowery and figurative style, and a scrupulous accuracy in the details; and how he has equally rivalled his two predecessors in their pecular excellencies.

Daubenton, however, so far forgot the little injuries of his old friend, that he afterwards contributed to several parts of the *Histoire Naturelle*, although his name was no longer attached to it; and we have evidence that Buffon had consulted the whole manuscript of his lectures in the College of France, when he wrote his *Histoire des Mineraux* [†]. Their intimacy was even perfectly re-established, and continued until Buffon's death.

During the eighteen years which the fifteen quarto volumes of the Histoire des Quadrupedes took in appearing, Daubenton was only able to give a few memoirs to the Academy of Sciences; but he subsequently indemnified it; for we find, in the collection of the Academy, as also in that of the Medical and Agricultural Societies of the National Institute, a considerable number, all of which contain, as well as the works which he published separately, interesting facts or new views.

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[*] The third volume, published in 1776, and the sixth in 1782, treat of quadrupeds, and would have had great need of Daubenton's assistance, as well as the seventh, which is posthumous, and was published in 1789.

[†] Published 1783 to 1788.

The bare enumeration of them would exceed the limits of a discourse like the present; and we shall content ourselves with briefly mentioning the principal discoveries with which he has enriched several departments of human knowledge.

In zoology, Daubenton discovered five species of bats [*] and a sorex [†], which had escaped the notice of other naturalists, although all pretty common in France. He gave a complete description of the species of small deer which produces the musk, and made some curious remarks on its organization [‡]. He described a singular conformation in the organs of the voice in some foreign birds [||]. He was the first who applied the knowledge of comparative anatomy to the determination of the species of quadrupeds whose remains are met with in a fossil state; and although he was not always happy in his conjectures, he nevertheless opened an important field of investigation in the history of the revolutions of the globe; he destroyed for ever those ridiculous ideas of giants, which had been renewed by each successive discovery of the remains of some great animal [§].

His most remarkable achievement of this kind, was the determination of a bone, which was kept at the Garde Meuble as the leg-bone of a giant. He discovered, by means of comparative anatomy, that it could only be the radius of a giraffe, although he had never seen that animal, and although no figure of its skeleton existed. He had the pleasure of verifying his conjecture himself, when, thirty years after, the museum procured the skeleton of that animal which it still possesses.

Before his time there were only vague ideas respecting the differences between man and the orang-outang. Some considered that animal as a wild man; others went so far as to maintain that it was man who had degenerated, and that his nature is to go on four feet. Daubenton proved, by an ingenious and decisive observation on the articulation of the head, that man could not walk otherwise than on two feet, or the orang-outang otherwise than on four [¶].

In vegetable physiology, he was the first who called the attention to the fact, that all trees do not grow by external and concentric layers. A palm trunk, which he examined, showed none of these layers. Excited by this observation, he perceived that the growth of that tree takes place by the prolongation of fibres from the centre, which are developed into leaves. He explained by this circumstance, why the trunk of the palm does not increase in thickness as it grows old, and why it retains the same size in its whole length*; but he did not push his inquiries farther. M. Desfontaines, who had observed the same circumstance long before, exhausted, so to speak, the subject, by shewing that these two modes of growth distinguish the trees whose seeds have two cotyledons, from those which have but one, and by establishing on this important discovery, a division which will for ever be fundamental in botany †.

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[*] Memoires de l'Academie des Sciences, for 1759, p. 61.

[†] Ibid. for 1756, p. 203.

[‡] Ibid. for 1772, second part, p. 215.

[||] Ibid. for 1781, p. 369.

[§] Ibid. for 1762, p. 206.

[¶] Ibid. for 1764, p. 568.

Daubenton was also the first who discovered tracheæ in the bark, that is to say, those shining elastic vessels, often filled with air, which others had discovered in the wood.

Mineralogy has made so much progress of late years, that Daubenton's labours in this department of natural history are now almost eclipsed, and, perhaps, there will only remain to him the glory of having trained to the science the individual who has carried it farthest: it was he who was M. Haüy's master. He published some ingenious ideas, however, on the formation of alabasters and stalactites ‡, on the causes of arborescences in stones ||, on figured marbles, and descriptions of minerals little known at the time §. It is true that his distribution of precious stones is not accordant with their true nature; but it gives at least some precision to the nomenclature of their colours ¶.

In all those writings there is evinced the peculiar kind of talent which he possessed,—a patience, which would never allow him to form conjectures respecting Nature, because it taught him not to despair of forcing her to explain herself, by repeating his interrogations,—and a sagacity which enabled him to seize the smallest signs that could indicate a reply.

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* Leçons de l'Ecole Normale.

† Memoires de l'Institut National, Classe de Physique, t. i.

‡ *Memoires de l'Academie* for 1754, p. 237. || Ibid. for 1782, p. 667.

§ Ibid. for 1781.

¶ See also his *Tableau Methodique des Mineraux*, of which the first edition was published in 1784, the fifth in 1796.

In his agricultural investigations an additional quality is manifested, namely, devotion to public utility. What he did for the improvement of our wool, will ever entitle him to the gratitude of the State, to which he contributed a new source of prosperity.

He commenced his experiments on this subject in 1766, and continued them until his death. Patronized at first by Trudainé, he received encouragement from all who succeeded that enlightened and patriotic minister, and he replied to them in a manner worthy of himself. He fully demonstrated the utility of keeping sheep constantly in the field; exposed the pernicious consequences of inclosing them in stables during winter*; tried various methods of improving the breed; found means for determining with precision the degree of fineness of the wool; discovered the true mechanism of rumination†; deduced useful conclusions respecting the temperament of woolly cattle, and the mode of feeding and treating them ‡; disseminated the products of his sheep-farm over all the provinces; distributed his rams among all the proprietors of flocks; had clothes made of his wool, to demonstrate to the most sceptical its superiority ||; formed expert shepherds for the purpose of propagating the practice of his method; and drew up instructions adapted to the capacity of all classes of agriculturists §. Such is a brief statement of Daubenton's labours in this important department.

Almost at every public meeting of the Academy, he gave an account of his researches, and frequently obtained more grateful applause from those present, than his fellow members received of admiration for discoveries more difficult to be made, but of less obvious utility.

His successes have since been surpassed; the entire flocks which the Government brought from Spain, at the request of M. Tessier, have diffused, and will continue to diffuse, the fine

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* Memoires de l'Academie for 1772, first part, p. 436.

† Ibid. for 1786, p. 389. ‡ Ibid. p. 393.

|| Memoire sur le premier drap de laine superfine du cru de la France, lu à la rentrée publique de l'Academie des Sciences de 1784.

§ Instruction pour les bergers et pour les proprietaires.

breed with more rapidity than Daubenton could do with rams only; but he has still the merit of having awakened attention to the subject, and of having done all that his means rendered possible.

By these labours he had acquired a sort of popular reputation, which was very useful to him in a season of danger. In 1793, a period already fortunately remote from us, when, by a derangement of ideas which will long be memorable in history, the most ignorant portion of the people had to pronounce upon the fate of the most accomplished and the most generous, Daubenton, now eighty years of age, required, in order to retain the office which he had honoured for fifty-two years, by his talents and virtues, to request from an assembly, which was named the *Section sans Culottes*, a paper, the equally extraordinary name of which was a *Certificat de Civisme*. A professor, or an academician, would scarcely have obtained it. Some prudent individual who had mingled with the outrageous mob, in the hope of keeping them within bounds, presented him under the character of a *shepherd*; and it was the Shepherd Daubenton that obtained the certificate necessary for the Director of the National Museum of Natural History. This certificate still exists; it will be a useful document, not only as connected with the life of Daubenton, but also as throwing light upon the history of that fatal period *.

These numerous labours would have exhausted an ardent activity. They did not satisfy the desire of a regular occupation, which formed a part of Daubenton's character.

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* COPIE FIGURÉE DU CERTIFICAT DE CIVISME DE DAUBENTON.

Section des Sans Culotte.

"Copie de l'Extrait des délibérations de l'Assemblée Générale de la Séance du cinq de la première décade du troisiemè mois de la seconde année dé la République Françoise une et indivisible.

"Appert que d'après le Rapport faite de la Société fraternelle de la section des sans culotte sur le bon civisme et faits d'humanité qu'a tujour témoignés Le Berger Daubenton, l'Assembleé Generale arrete unanimement qu'il lui sera accordé un certificat de Civisme, et le Président suivie de plusieurs membre de la dite assemblé lui donne l'acolade avec toutes les acclamation dues a un vraie modèle d'humanité, ce qui a été témoigné par plusieures reprises.

Signé "R. G. DARDEL, *Président.*

"Pour extrait conforme,

Signé "DOMONT, *S.*^{tair}"

It had long been a subject of complaint, that there were no public lectures on natural history in France. He obtained, in 1773, an order that one of the chairs of practical medicine in the college of France, should be changed into a natural history chair, and in 1778 he undertook to fill it. The Intendant of Paris, Berthier, engaged him, in 1783, to give lectures on rural economy, at the Veterinary School of Alfort, at the same time that Vicq d'Azyr delivered lectures on comparative anatomy, and M. de Fourcroy on chemistry.

He also wished to give lectures in the Cabinet of Paris, where the objects of natural history would have spoken with still more perspicuity than the professor; but not being able to obtain permission under the old regime, he joined along with others employed in the Garden of Plants, in soliciting the Convention to remodel that establishment into a regular school of natural history.

Daubenton was named Professor of Mineralogy to it, and he fulfilled the duties of this office until his death, with the same correctness which he employed in all his functions.

It was truly an affecting thing to see this old man surrounded by his pupils, who received with a religious attention his words, which their veneration seemed to convert into so many oracles; to hear his feeble and tremulous voice become again animated, and resume strength and energy, when he had to inculcate some of those great principles which are the result of the meditations of genius, or only to unfold some useful truths resulting from them.

He had no less pleasure in speaking to his pupils than in hearing them speak: it was seen by his amiable cheerfulness, and the ease with which he answered all their questions, that the occupation was a true pleasure to him. He forgot his years and his weakness, when he had an opportunity of being useful to his pupils, and of fulfilling his duties.

One of his colleagues having offered, when he was named to the office of senator, to relieve him in his teaching; "My Friend," he replied, "I cannot have a better substitute than you; when age forces me to give up my functions, be assured that I shall confer them upon you." He was then eighty-three years of age.

Nothing can better prove his zeal in behalf of the students, than the pains which he took to keep up with the progress of science, and not to imitate those professors who, once fixed in a situation, never vary their lectures. At the age of eighty, he was seen obtaining an explanation of the discoveries of one of his oldest pupils, M. Haüy, and labouring to apprehend them, that he might be able to impart them again to the young people whom he taught. Such an example is so rarely to be met with among the learned, that it must be considered as one of the finest traits in Daubenton's character.

During the ephemeral existence of the Normal School, he delivered some lectures there. He was received with the most lively enthusiasm whenever he made his appearance, and applauded, as often as he introduced the sentiments by which that numerous auditory were animated, and which they rejoiced to see possessed by the venerable old man.

We have now to speak of some of his works, which are less destined to make known discoveries, than to give a systematic account of some body of doctrine; such as his articles for the two Encyclopædias, and especially for the Encyclopedie Methodique, in which he composed the dictionaries for quadrupeds, reptiles, and fishes; his *Tableau Mineralogique*, and his lectures at the Normal School. He has left the entire manuscript of those of the Veterinary School, of the College of France, and of the Museum. It is to be hoped that they will not be withheld from the public

These didactic writings are remarkable for great perspicuity, sound principles, and a scrupulous exclusion of every thing doubtful. The only astonishing thing in them, is to see that the man who had reasoned with so much force against all classification in natural history, should have ended with adopting arrangements which are neither better than, nor perhaps so good as, those with which he found fault, as if he had been destined to prove by his own example how much his first prejudices were contrary to the nature of things and the constitution of man.

Lastly, Besides all these works and lectures, Daubenton was also employed as a contributor to the *Journal des Savans;* and in his last years, at the request of the Committee of Public Instruction, he undertook to compose Elements of Natural History for the use of the higher schools. These Elements were never finished.

It may be asked how, with a weak habit of body, and so many laborious occupations, he could have attained so advanced an old age without painful infirmities. For this he was indebted to an ingenious study of himself, an attention calculated equally to avoid excesses of the body and mind. His regimen, without being severe, was very uniform; having always lived in easy circumstances, and not holding fortune and grandeur in higher estimation than they merit, he had little desire for them. He had especially the strength of mind to avoid the rock on which almost all literary men are apt to suffer shipwreck, an intemperate passion for a premature reputation; his researches were to him an amusement rather than a labour. Part of his time was employed in reading romances, tales, and other light works, with his wife; the more frivolous productions of our days were read by him: he called this *mettre son esprit à la diète.*

Unquestionably this regular mode of living, and his constant good health, contributed much to the amenity which rendered his society so agreeable; but another trait in his character, which did not less contribute to this effect, and which struck all who came near him, was the good opinion which he appeared to have of men.

It seemed naturally to arise from the circumstance that he had seen little of them,—that, being solely occupied with the contemplation of nature, he never took part in the plans and movements of the active portion of society. This man, possessed of so delicate a tact in distinguishing error, never had the air of supposing deceit; he always experienced new surprize when the intrigue or selfishness, concealed under a fair exterior, were unveiled to him. Whether this disposition was natural to him, or whether he had voluntarily renounced the knowledge of men, to spare himself the pain and disgust which those feel who know them too well, it did not the less diffuse over his conversation a tone of good nature, so much the more amiable that it contrasted strongly with the intellect and acuteness which he carried into every thing that related merely to reasoning. To approach him was to love him; and never did any man receive more numerous testimonies of affection and respect from others, at all the periods of his life, and under all the successive governments.

He has been reproached with having submitted to a homage unworthy of himself, and odious from the very names of those who rendered it to him; but this was a consequence of the system which he had adopted, of judging even public men by their words, and of never suspecting any other motives than they expressed;—a dangerous method, no doubt, but one which has perhaps been a little too much abandoned at the present day.

Another disposition of his mind, which also contributed to those odious imputations of pusillanimity or self-conceit which have been brought against him, even in printed works, and which, however, does not the more justify them, was his perfect obedience to the law, not as being just, but simply as law. This submission to human laws was absolutely of the same nature as that which he had for the laws of nature; and he no more permitted himself to murmur against those which deprived him of his fortune, or of the rational use of his liberty, than against those which caused his limbs to be deformed by the gout. Some one has said of him, that he observed the knots on his fingers with as much coolness as he would have observed those of a tree; and this was true to the letter. This was equally true of the coolness with which he would have given up his offices and emoluments, and gone into exile, had the tyrants required it of him.

Besides, admitting that when the maintenance of his tranquillity might have been the motive of some of his actions, will not the use which he made of that tranquillity justify him? And this man, who could wrest so many secrets from nature, who laid the foundations of an almost new science, who gave to his country an entire branch of industry, who erected one of the most important monuments of science, who formed so many accomplished pupils, of whom several have already attained the highest rank among the learned, will such a man require, at the present day, that I should justify him for having managed the means of doing all this good to his country and to humanity?

The universal acclamations of his fellow-citizens reply for me against his accusers; the last and most solemn marks of their esteem terminated, in the most glorious manner, the most useful career; perhaps we have to regret that they shortened its course.

Having been named a member of the Conservative Senate, Daubenton wished to perform his new duties in the same manner as he had done those of his whole life, and was in consequence obliged to make some change in his regimen. The season was very severe. The first time that he assisted at the sessions of the body which had elected him, he was struck with apoplexy, and fell senseless into the arms of his astonished colleagues. The most prompt assistance could only restore him to feeling for a few moments, during which he shewed himself what he had always been—a tranquil observer of nature; he felt with his fingers, which still retained sensation, the various parts of his body, and pointed out to the assistants the progress of the disease. He died on the 31st December 1799, aged eighty-four years, without suffering; so that it may be said of him, that he attained happiness, if not the most splendid, at least the most perfect, and the least mixed, that man could hope to attain.

His funeral was such as was merited by one of our first magistrates, one of our most illustrious men of science, and one of our most respectable fellow-citizens. The citizens of all ages and ranks considered it an honour to render the testimony of their veneration to his ashes. His remains were deposited in the Garden which had been embellished by his care, which his virtues had honoured during sixty years, and of which his tomb, according to the expression of a man who does equal honour to science and the senate, will form an elysium, by adding to the beauties of nature the charms of feeling. Two of his colleagues have been the eloquent interpreters of the regrets of all who knew him. Pardon me, if these painful feelings still affect me to such a degree, that I can only be the interpreter of the public gratitude; and if they lead me from the ordinary tone of an academic eulogium, pardon him whom he honoured with his friendship, and of whom he was the master and the benefactor.

Madame Daubenton, who is known in the literary world by her amusing works, and with whom he lived for fifty years in the closest bonds of mutual love, brought him no children.

He was succeeded at the Institute by M. Pinel, and at the Museum of Natural History by M. Haüy. I have had the honour of being chosen in his place in the College of France.

Remarks on the Probability of reaching the North Pole: being an examination of the recent Expedition under Captain PARRY, *in order to the inquiry, How far that experiment affects the Practicability of the Enterprize?* By the Rev. WILLIAM SCORESBY, F. R. S. Lond. & Edin., M. W. S., Correspondent of the Institute of France, &c. &c. Communicated by the Author*.

FROM the circumstance of the original proposal of the project for reaching the Pole, by a journey over the ice, having been first made to the Wernerian Society †, and received by that Society, apparently, with favourable consideration, I venture to renew the subject, after a lapse of thirteen years, in the hope, notwithstanding the recent failure of Captain Parry in this same adventure, of still justifying the proposition, upon the very plan originally suggested, and of proving to the Society, that the probability of success, if at all diminished, is by no means overturned.

Hitherto I have studiously forborne to make remarks on the various expeditions of late years employed in Arctic explorations, for reasons not necessary to be named; but any longer to remain silent, after the recent result, would indicate, either that the severe censure of a writer in the Quarterly Review was not undeserved ‡, or, at least, that the late trial was a decisive experiment; neither of which suppositions I should think myself justified in admitting. And, whatever may be due to myself in vindication of the project to which I refer, I consider it due to the Society, to whom the project was originally submitted, and to the country by which the expence of the recent exploration and experiment is borne, to state the reason I have for believing that the British flag, under more happy arrangements, might yet be planted upon the Pole.

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* Read before the Wernerian Society, June 1828.

† Society's Memoirs, vol. ii. pp. 328--336. Read 11th March 1815.

‡ The passage to which I refer, occurs in a note, under an article headed "Burney—Behring's Strait, and the Polar Basin." It is as follows, "Captain Scoresby might well anticipate, that his idle and thoughtless project of travelling over the ice of the sea to the North Pole, may be deemed 'the frenzied speculation of a disordered fancy.' We regret that a young man, of some talent, should have been betrayed, by a desire to make the vulgar stare, into such an inconsistency; but it has served Malte Brun for an argument, such as it is, against the existence of the *Polar Basin*. One would have thought, that a person of his reading and sagacity might have seen the absurdity of such an idea; and that, even supposing the Polar Sea to be frozen, it

Had the expedition, indeed, of Captain Parry proved successful, I should have left it to the public to do me the justice of having first suggested the plan of this mode of approach to the pole; but as, in consequence of its failure, no credit is to be acquired by claiming it, I may, without the selfish charge which might have attached to such a claim, under circumstances of complete success, be bold to acknowledge the project, as well as ready to defend it.

My object in this communication, as just intimated, is to prove, that, whatever probability there at any time was of reaching the pole, by a journey over the ice, remains little, if at all, diminished by the late experiment of Captain Parry; because there were two circumstances in the plan of it, (and it is somewhat remarkable, that these are almost the only material deviations from the original plan that I have been able to discover), either of which appeared to me obviously fatal to the success of the expedition. And, besides these two grounds of failure, both capable of being anticipated, by a thorough acquaintance with the nature of the Spitzbergen ice, there is another that has been disclosed by the peculiar difficulties of the recent experiment, which, equally with the other two, must have contributed to the failure. Respecting the importance of these considerations, however, it will be for the Society and the public to judge, whether they are indeed essential considerations; and if so, whether, under a different arrangement, a much greater progress, if not an entire execution of the project, might not, in all probability, have been effected.

After what Captain Parry, however, has said, at the conclu-

would present a surface so rugged and mountainous, as to make it an easier task to drive a broad-wheeled waggon over the summit of Mont Blanc, than a reindeer sledge to the North Pole."—*Quarterly Review*, vol. xviii. p. 451.

sion of his narrative, in vindication of the plan of his recent expedition *, it might seem captious in me to start objections, or presumptuous to think of proposing a better plan; but I would venture to appeal to the opportunities for observation, and the extensive experience which twenty-one voyages to the Greenland whale-fishery have afforded, for forming a decided personal judgment, in respect to an adventure of the nature of that under consideration.

But I proceed to state the several considerations in the plan of the expedition, all capable of a different arrangement, to which I have referred above, as essentially affecting the result of the expedition. These are, *The weight of the sledge-boats; The season of the year at which the experiment was tried;* and, lastly, *The meridian upon which the party travelled.*

I. *In regard to the Weight of the Sledge-Boats.*

The mode of travelling, by which it always appeared to me that the journey to the pole might be attempted with the greatest hope of success, was by light sledges or sledge-boats, drawn by dogs or reindeer; but in the event of the failure of these animals on the journey, it did not seem to me impossible (and much less so since the expedition of Captain Parry) that the return, or indeed the whole journey, might be effected on foot, with hand-sledges for the provisions and apparatus †. The sort of sledge I suggested "might consist of slender frames of wood, with the ribs of some quadruped for lightness and strength, and coverings of water-proof skins, or other materials equally light ‡." Something of the nature of the Esquimaux *umiak*, or women's boat, for instance, which, although 30 feet or upwards in length, and capable of carrying from ten to twenty persons, besides their domestics and fishing utensils, is yet so light, that, when the Esquimaux are performing a voyage in it

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* Captain Parry does not speak of his experiment as conclusive; but he says, "that the object is of still more difficult attainment than was before supposed, even by those persons who were the best qualified to judge of it, will, I believe, appear evident from a perusal of the foregoing pages; nor can I, after much consideration, and some experience of the various difficulties which belong to it, recommend any material improvement in the plan lately adopted."—*Narrative*, p. 142.

† Wernerian Memoirs, vol. ii. p. 330–1. ‡ Id. 331. Note.

(which they sometimes do to the extent of 100 or 200 miles), and meet with any interruption, six or eight persons can take the boat upon their heads, and carry it over either land or ice to the next convenient place of embarkation *. A boat of a description somewhat resembling this, but smaller, and placed upon a light sledge-frame, or cradle of wood, would, I apprehend, answer the purpose; for whilst the lightness of its structure would render it easily portable, the sledge-frame would defend it from being cut or chafed by the ice; and, indeed, whenever any cut or rent might occur, the fissure, after the manner of the Esquimaux, could be easily and expeditiously repaired.

The great difficulty always experienced in launching whale-boats over the ice,—a means which must often be resorted to in the whale-fishery, either when boats are upset or an entangled whale takes refuge within a close boundary of ice,—forcibly impressed me with the conviction that no boat of ordinary weight could possibly be used in performing a successful journey to the pole. And, on reading Captain Parry's narrative of his late experiment, I was much more struck by the immense difficulties their hearty exertions enabled them to surmount, notwithstanding all the disadvantages under which they laboured, than by the want of greater success. And in farther proof of my previous personal conviction of the vital importance of the weight of the boats, I may be permitted to mention the fact, that, when I first heard from a near relative of Captain Parry's, whilst the expedition was yet abroad, that the sledge-boats were each of the weight of near three quarters of a ton, I expressed the strongest conviction that this circumstance alone *must* be fatal to success; and I moreover added, that, from my intimate knowledge of the nature of the ice, and the difficulties to be encountered, I should feel perfectly secure in venturing any consideration whatever in support of the belief that *it was impossible to succeed* †.

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* Crantz's Greenland, vol. i. p. 148–150. The length of the umiak Crantz states at "commonly 6, nay 8 or 9 fathoms long." Also Saabye's "Greenland," p. 18–20.

† This conversation occurred at a dinner party in Liverpool, with my intelligent and scientific friend the Rev. Edward Stanley, Rector of Alderley, on the 4th of September 1827. Captain Parry was not heard of till towards the end of the month, having arrived at the Admiralty on the 29th.

Now, that this arrangement of itself, under existing circumstances, must have been fatal to success, I think we may derive strong evidence, if not decided proof, from the words of Captain Parry. For so laborious was the nature of the service (owing, no doubt, in one essential respect to the state of the ice), that Captain Parry informs us that the most of the journey was performed from three to five times over the same ground; so that, whilst the direct distance accomplished towards the pole (including 100 miles of free navigation from the Hecla to the margin of the packed ice) was only 172 miles, the actual distance travelled was no less than 978 miles *, being sufficient, could it have been performed in a direct line, to reach within two degrees of the pole, and return!

Now, the only question in regard to this argument is, Whether, in the unfavourable and unexpected state in which the ice was found, and I may add unusual state, with a sledge-boat of light materials, such as I have briefly described, they could not have accomplished the journey by one single flexuose line, instead of passing three or five times over the same ground? I speak not here of the objection of any want of safety in such a conveyance, in the event of having to cross large openings of water, for that will be considered hereafter. The conclusion I should draw from reading the narrative is, that, in a sledge-boat of 400 lb. or 500 lb. weight, instead of 1540 lb., with hand-sledges for apparatus, &c. there would seldom have been occasion to go over the same ground twice. Of this, however, I can give no proof, neither can any one; it is merely a matter of judgment, and that judgment can only be valuable or satisfactory according to the relative experience and capabilities of the persons whose opinions may happen to come into competition. At all events, it must be perfectly certain that a reduction of 2000 lb. weight in the two boats, out of 7506¼, being more than one-fourth of the total weight, and diminishing by expenditure of stores to one-half, must have afforded a chance of success very far beyond the extent actually accomplished. And even this conclusion, which appears inevitable, will be sufficient for the support of my argument; because, whether, in my proposed sledge-boats, the expedition lately undertaken could

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* Narrative, p. 128.

have gone forward at a constant progress, or whether, in some few cases, the party must have made a second trip; yet, upon such ice as they would have met with at a different season, and on a different meridian, there can be no doubt but a constant progress, unless in some very extraordinary cases, would have been made: And if so, no new obstacles occurring, even at the slow rate at which they actually travelled, the whole distance to the pole, if a few days more time had been given to the task, might have been accomplished.

II. *In regard to the Season of the year at which the Experiment was tried.*

But the weight of the boats was not the only consideration that essentially affected the final result,—THE SEASON OF THE YEAR at which the experiment was tried was perhaps *the most unfavourable* that could have been selected. This may appear a gratuitous assertion, especially when put along with Captain Parry's opinion before quoted; with which opinion, however I am disposed to respectful deference, I cannot coincide, unless the arguments which appear to me to be so conclusive against it, can be repelled and refuted.

Without stating these arguments formally, I shall briefly mention what the views are which I have always held as to the best season for undertaking such an expedition; and then the *peculiar* and formidable difficulties which Captain Parry encountered, arising out of the season at which his adventure was undertaken, will naturally constitute both argument and ground of proof.

The original plan which I had the honour of submitting to the Society in the year 1815, I find, on carefully reviewing it, as still affording, in my opinion, the best chance of success in any attempt for reaching the pole; though there are a few minor circumstances, which an experience of several additional voyages among the polar ices would now induce me perhaps to modify. But the great outline of the plan I would still justify as feasable, and as being well adapted to the peculiarities and the difficulties of the bold adventure; and there are few parts of the plan which I should consider of more importance than that relating to the season for making the experiment: For the occurrence of detached ice and soft snow are obstacles which always appeared to me so formidable, as to require, if possible, to be avoided. To effect this, I suggested, in the original plan, that "*it would be necessary* to set out by the close of the month of April or beginning of May; or at least some time before the severity of the frost should be too greatly relaxed *."

A very brief mention of the well-known changes which take place in the polar ices on the approach of summer, will suffice to shew the importance of this suggestion. During the continuance of the frost below 28½° Fahr. (the freezing point of sea-water), the small interstices among drift ice, and the greater spaces among fields, are generally filled up by "bay-ice." So that, in the midst of a body of drift ice, where no original mass should exceed 100 yards in diameter, or indeed any smaller maximum, the whole body, in the spring of the year, is generally cemented into a continuous field; and this, in situations sheltered from the action of the sea, often partakes so much of the nature of a field, that there is no difficulty in walking over such ice for many leagues together, without ever requiring the aid of a boat. Hence, in the months of April and part of May (probably the whole of May in latitudes to the northward of Spitzbergen), the entire body of the Spitzbergen and Greenland ices greatly partakes of the nature of continuous fields. Sometimes, indeed, the field ice gets separated to the westward of Spitzbergen before that time; but this is unfrequent. It is at that time, therefore, when the drift-ice is thus cemented into field-like continuity, and when the field-ice is often found in uninterrupted connection, from the filling up of the interstices with bay-ice, that the Arctic ices are unquestionably in a better state for the progress of travellers, than at any other season at which the 80th degree of latitude could be reached without wintering. And at this season, when the snow is yet undissolved, and *occasionally* hard upon the surface,—when there is no water whatever upon the ice, no rain to impede or incommode the adventurers, and no needle-like crystals to distress them,—then, I should consider that the experiment would have every reasonable chance of success.

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* I ought perhaps to apologise to the Society for this and some other references to my own publications; but I am under the necessity of doing so, to avoid the imputation of first deriving information from Captain Parry's experiment, and then using that information as an argument for a new plan, suggested by the causes of the recent failure. My object in these references is to prove that I am not taking up new views; but justifying the original plan.

Besides, when the ice is in this continuous and favourable state, the adventurous party might avail themselves of the use of reindeer or dogs to drag their light sledges across the northern fields or floes, which, besides affording them relaxation from too arduous exertion, would yield a valuable reserve of nourishment (however painful such an application of these useful animals), either in case of resources failing them, or, what might easily happen, any of the provisions being lost.

But on the abatement of the frost, the change that takes place is not less detrimental to the success of a superglacial journey, than it is astonishing in itself. For every whale-fisher knows by hard-bought experience, that the cementation of the drift-ice, which in April and May presents so formidable an obstruction to the progress of a ship that it frequently costs him hours and days of hard labour to advance a few fathoms, is in June or July so completely dissolved, that he can often sail through the very centre of the same body of ice in any direction, without ever stopping!* And he is equally familiar with the fact, that the tendency of the ice, which during the frost is to form into compact streams and continuous bodies, and tenaciously to adhere as if by general attraction, is so changed on the cessation of the frost, especially in July and August, that the adhesive tendency is quite reversed, and there now seems to be a universal repulsion; so that in places where there is space for it to separate, and when there is no action of a swell to bring it together, no two pieces of ice can be said to be in contact! What a serious obstacle such a change in the condition of the ice, as to continuity, must present against the polar journey, will be evident, even to persons who have never witnessed the fact, without a word of argument or illustration!

It has been necessary to enter into these explanations, that the Society may judge of the defects in the plan of the recent expedition, which it is my object in this part of my communication to endeavour to point out, that no one may be obliged to rest in doubt because of conflicting opinions; but may have the opportunity of discerning how far my objections are convincing, and whether or not they are conclusive.

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* Account of the Arctic Regions, vol. i. 274–5.

To this end, as far as relates to the argument in respect to the importance of the time of the year for trying the experiment, I have only, in addition to what has been said, to direct the attention of the Society to several formidable difficulties which Captain Parry encountered, arising entirely out of the advanced state of the season, which proved one of the chief and obvious causes of the want of greater success.

From the want of continuity among the ice, small spaces being continually met with during their entire progress, they were frequently subjected to the arduous service of unloading and loading their boats, and of launching and hauling them up, which laborious routine they had sometimes to perform eight or ten times a-day, and once no less than seventeen times during one day's journey *.

From the quantity of rain which fell, the people were both injured as to their strength and comfort, and their progress was often retarded for hours together †.

From the snow on the ice being saturated with water, not only were the men's feet continually wet, and their physical energies considerably enervated, but the adhesion of their feet to the wet snow rendered the movements of the travellers so difficult, that in some cases they had to advance upon all-fours, and in other cases they fairly stuck fast ‡.

From the partial dissolution of the ice, or rather probably from the resolution of a portion of the winter's covering of snow into prismatic or pyramidal needles, the progress of the party was often rendered difficult and painful, in consequence of the piercing of their feet by these pointed crystals.

And from the quantity of water found on the floes, they had sometimes, when it was not deep enough to float their boats, to make considerable circuits, instead of pursuing their course through the body of these lakes, a line which, had it been free from water, would have always proved the best and most level track.

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* Narrative, p. 143.

† Id. p. 71, 78, 84, 85, &c.

‡ Id. p. 71.

Now, I have no hesitation in asserting, without the fear of contradiction, that whatever other peculiar difficulties may belong to the season I have suggested, none of these striking and formidable peculiarities would have been met with, except the first, and that that difficulty would necessarily have occurred much less frequently, and, possibly, for days together not at all. Because in the month of May, as I have already said, the general character of the ice is field-like, and the constant tendency to be continuous;—because in May there is no rain, except at the borders of the ice, and even there it is so uncommon as to be quite a phenomenon;—because in May the surface of the ice, where bare of snow, though having a granular roughness, is free from sharp crystals;—and because in May the snow upon the ice is unmixed with water, and no pools or lakes, unless from orifices admitting ponds of sea-water, which are not frequent, occur on the floes. That the disadvantages belonging to the *season*, therefore, at which the adventure was undertaken, are great and formidable, and for the most part might be avoided, I trust what has been said amounts to proof.

I must not neglect, however, to concede to the plan of the recent expedition an accidental delay of almost twenty-one days, nor would I omit acknowledging that this brief space of time might have proved of much importance to their greater success, by enabling them to reach the field-ice before the commencement of the rains. It was the intention of Captain Parry to have "set out from Spitzbergen, if possible, about the beginning of June, and to occupy the months of June, July, and August in attempting to reach the Pole, and returning to the ship *;" but, in consequence of the instructions which had been given him, he had first to find a place of security for the ship, in effecting which, in connection with several days besetment in the ice, he was so delayed that he was not able to proceed on his expedition until the 21st of June. No doubt he would have been justified in departing from his instructions in this particular, as he had indeed designed, could he have left the Hecla in a place of probable safety, and with a competent crew. But the situation on the northern face of Spitzbergen on which they sought for shelter (probably owing to their being forced thither by the ice), and the coast from whence they proposed to set out, were far from being the most favourable as safe retreats; nor was the remaining crew in the Hecla adequate to take charge of the ship under any difficult circumstances.

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* Introduction, p. xiii.

III. *In regard to the Meridian upon which the Party travelled.*

The two objections against the plan of the recent expedition that I have now urged, and endeavoured to substantiate —concerning the weight of the sledge-boats, and the season of undertaking the enterprize, either of which appears to me to be of such consequence as necessarily to be fatal to success—are not objections *suggested* by the failure of the expedition, though they receive the strongest support from the circumstances of the failure; but they are objections, as I have shewn, one of which was, and the other, had it been known, would have been, anticipated. There is another objection, however, to the plan of the late experiment already hinted at, which has been developed by the perusal of the Narrative, and this likewise must have had a most important influence in diminishing the chance of success; and that is, *the particular meridian on which the expedition made the trial.* They set out from the northern, approaching the north-eastern face of Spitzbergen, by which, indeed, they gained from 40 to 60 miles of northing, beyond the ordinary extent of navigable sea to the westward of Spitzbergen, before they took the ice; but this small advantage was far from being a compensation either for the detention of twenty days, or for the extraordinary difficulties as to the *nature* of the ice which they encountered.

It is but proper, however, to state, that the choice of this meridian rather than a more westerly one, was probably urged by the circumstance of the Hecla having got beset in the northern ice, and being driven towards that meridian along with the pack. It would not be just, therefore, to consider that so much an error in the plan as an unfortunate circumstance, materially affecting, as the result shewed, the execution of the project, by throwing them in the way of such a rough and untoward congeries of pack and floe ice, as no human energies, circumstanced as in other respects they were, could have a prospect of surmounting.

In the plan which I had in view, when I before addressed the Society on the subject, Magdalena Bay, Smeerenberg, or some other of the anchorages about Hakluyt's Headland, was the retreat, if any were made use of, which I should have suggested for the ships; because, there is little fear of ice setting down upon any of these in the summer; and they afford a safe outlet for returning even at a late season in the autumn. But I should have proposed,—not to attempt to secure the ship before setting out, as that, as in the case of Captain Parry, would be liable to occasion great and unnecessary delay,—but to carry the travelling party direct to the main border of the northern ice, either on the meridian of Hakluyt's Headland, or a few degrees of longitude to the westward of it, if a higher latitude could be there attained. I would then penetrate the loose ice, provided it could be done without risk of hampering the ship, to obtain the chance, which the experience of some occasions that I have seen holds out, of planting the travellers at once upon the field-ice *. The ship, then, being left in adequate charge, and with a full complement of men, independent of the travelling party, might, during the next month or two, pursue any object in the immediate neighbourhood that should be deemed desirable, having first landed, at assigned places, abundant resources for the travellers on their return, in the event of any accident happening to the ship. Then, in good time for the return of the expedition, the ship might take its station on the face of the northern ice, and cruize between certain meridians previously agreed upon with the travelling party. By that means there would be a fair probability of receiving them upon their return, without subjecting them to the risk of crossing in their slight canoes the open space of water between Spitzbergen and the ice. And to avoid inconvenience, in case of the boats,

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* This was practicable in the spring of the year 1803, when, in a ship commanded by my father, we reached the northern floes beyond the 80th degree of latitude, before the end of April. In 1808, a *remarkably close season*, we were on the borders of the main northern floes in latitude 80½ to 81°, from the 18th to the 20th of May. In 1814, we reached the field-ice in latitude 79°½ on the 20th of May. But it was seldom our object to reach the northern fields beyond the 80th degree, else, no doubt, we might frequently have done so early in May.

from foggy weather or any other cause, missing the ship, and making their way to the place of rendezvous, a commodious boat or cutter might be left on the spot, fitted out for the purpose, in which some of the party might return to the northward, and make known their arrival to the ship.

On this plan, as to the meridian of embarkation, two or three particular advantages would be gained over the plan of the recent expedition, and very probably a third, the most important of all. The station of embarkation would, in all probability, be accessible at a season sufficiently early for the expedition, that is, by the end of April (or earlier, if desirable) in *open seasons*, or, by the middle of May, or very soon after, in usual *close seasons*. And this would secure the season, considered as favourable for the undertaking, without involving the expence, annoyance, and general disadvantage of wintering *.

A second advantage would be, that the expedition might start without the ship being secured in harbour, there being exceedingly little risk of, a ship getting hampered by ice in that situation, unless by carelessness or ignorance, as the western part of the coast is the most open, and probably the longest open of any of the coasts of Spitzbergen. And a third advantage most probably would arise,—nay, I can have no doubt, from many years' observations, that it would arise,—that, on the proposed meridian, *field-ice* would certainly be met with, and that at no great distance from the extreme or seaward edge. And of this, I conceive that I could shew evidence of the strongest probability, if not evidence in proof.

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* Captain Parry having expressed an opinion contrary to this (Narrative, p. 144), I must appeal to the experience of twenty-one years' observation on the whale-fishing stations for proof.

In the ten years between 1803 and 1812 inclusive, the Spitzbergen seas were unusually encumbered with ice, there having occurred but ten "open seasons," in which access to the usual highest latitudes might be had in the month of April; but during the same ten years, with one exception, and not speaking of two other years in which we made no attempt, the 80th degree of latitude was always reached during the month of May, and was in general accessible by the middle of May. During the next ten years, from 1813 to 1823 (omitting 1819, when I did not visit the fishery), there occurred seven "open seasons," in six of which we actually proceeded to as high a latitude as we wished (generally 78°½ to 79°), and, without doubt, might have proceeded farther, as early as the middle, or, at least, before the end of April; and during the other three years, out of the ten, we attained the highest northern latitudes we wished, once on the 1st, and another time on the 4th, of May,—and, in the remaining year, which was the only really "close season" in the ten, we made our fishery "to the southward," and had no occasion to try the experiment. In the cases just stated, where we stopped short of the 80th degree of latitude, there need be no question of that parallel being accessible; for, it is a general fact, in respect to the conformation of the Spitzbergen ices, that, whenever the latitude of 78° or 78°½ can be reached *in-shore*, the 80th degree is usually attainable; for whatever prevalent winds or currents clear the ice from the land in the 79th parallel, always tend to clear a passage to the northward as far as latitude 80°.

It was matter of great surprise and mortification to our late ice-travellers, that, during the whole of their arduous progress, they never reached "the main body of field-ice," which other navigators have described. Hence Captain Parry is reduced to the necessity, as he found no such ice, to explain the difference of his experience, on the supposition, that other navigators, having chiefly seen the ice from the mast-head of their ships, without travelling upon it, must have been deceived. For, "as it is well known how much the most experienced eye may be deceived, it is possible enough," Captain Parry remarks, "that the irregularities which cost us so much time and labour, may, when viewed in this manner (from an elevated situation), have entirely escaped notice, and the whole surface appeared one smooth and level plain *."

That the irregularities of the ice, as seen from an elevated position, would appear fewer and less considerable than they really were, is perfectly certain; but it is equally certain, as certain as the eye can be of any thing it perceives, that no experienced person can mistake, when he reaches the borders of it, drift-ice for fields; nor will he be liable to be deceived, as I well know from innumerable trials, as to the nature of the ice, of which he has a distinct view, even at the distance of several furlongs.

Hence I consider it as certain, that the ice Captain Parry met with had either been accumulated there by some unfavourable action of the winds and currents, or that its deficiency in field-ice was owing to some peculiarity as to the meridian on which he travelled. For, in his "Narrative," he tells us, that the ice in one case was so exceedingly rough, that "the men compared it to a stone-mason's yard;" and as a general observation, that

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* Narrative, p. 146–7.

"the nature of the ice was beyond all comparison the most unfavourable for their purpose that he ever remembered to have seen." In fact, Captain Parry never reached *the fast ice*, though he was evidently near either it or some extensive land, as proved beyond any doubt by the yellow ice blink that was seen to the northward of them, when they found it necessary to return. And it appears not improbable, from the experience which this trial gives, that there is land not only to the eastward, but also to the north-eastward of the Seven Islands*, from the proximity of which the ice had been raised into such formidable hummocks, and broken into such small masses. For, on some meridians, and no doubt to the westward of Hakluyt's Headland, we know that there always is a vast body of field-ice, from the circumstance of that kind of ice being frequently traced, in one continuous chain, from the 80th to the 74th degree of latitude, or indeed as far to the southward as the whalers have penetrated. And that there is abundance of the same to the northward of the 80th parallel, is certain, from the circumstance of the constant south-westerly set, during the summer, of the whole body of ice between Spitzbergen and Greenland, and the constant succession of other fields descending from the north or north-east to supply its place†. And it is ice of this nature, to a great extent at least, that we should have good reason to calculate on meeting with, and upon this, the journey to the pole with rein-deer, or other traineaux, might, in reasonable probability, be accomplished; notwithstanding the broken, rugged, and unfavourable nature of the ice met with by Captain Parry, owing to which, among other causes already stated, his rein-deer were rendered useless, and so little success was attained.

That the kind of ice across which Captain Parry travelled, was something *peculiar* to the meridian wherein his progress was made, appears certain from this fact, that, in the whole course of my experience among the Arctic ices, during which I probably traversed among not less than twenty thousand leagues of ice, I never met with any ice, except icebergs about the shore, at all resembling the scene represented in Captain Parry's Narrative, in the plate entitled "Travelling among hummocks of ice." These hummocks, in proportion to the men, appear to be from thirty to fifty feet high, or upwards, whereas the ordinary hummocks of the heaviest field-ice that occur in ridges or groups, seldom exceed twenty or thirty feet high, and hummocks of forty feet are not of usual occurrence, though an insulated peak of that height may be seen occasionally. Besides, the want of field-ice was of itself a decisive proof of an unfavourable situation. The largest floe that Captain Parry fell in with was only two and a-half or three miles square,—the only occasion in which they saw any thing answering, in the slightest degree, to the description given of the "*main ice*;" yet no fields were met with *. Whereas, as I have already shewn, field-ice, to the westward of Spitzbergen, has often been traced, in a continuous chain, through an extent of six to ten degrees of latitude. In respect to the extent of the different masses, I may remark, that whereas the greater proportion of the ice may consist of floes of various magnitudes, a very considerable quantity is often found of the nature of fields, that is, of such large dimensions, that an observer from a ship's mast-head cannot overlook them. And, in regard to the nature of the surface of these floes and fields, I may add, that, although the greater number, perhaps, may exhibit a hummocky appearance, fields and floes, containing an even surface, for an extent of miles together, are quite common.

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* Captain Parry saw land to the eastward of the Seven Islands; and in some of the old Dutch charts there is an extensive tract marked out still farther to the northward, and designated by the name of "Purchas' Land," or "Purchas's Point," or "Giles's Land."

† The proofs of these facts being given, both in the paper on the "Polar Ice," (Wernerian Memoirs, vol. ii. pp. 309, 318), which I had the honour of submitting to the Society, and also in the "Account of the Arctic Regions," (See vol. i. p. 212, 217; also p. 246 and 290–296); it is needless to repeat them here.

Having, for some years, been in the habit of observing the nature of the Arctic ice in reference to the practicability of a journey to the Pole, I find, on reviewing my journals, several remarks expressly on the subject. Thus, in my manuscript journal for 1820, I find mention of a field remarkable for its size. We sailed along its solid continuous edge N. NE. 12 miles; N. 4 miles; and N. NW. 8 miles; and were yet far from its northern extremity. It was calculated to be 150 miles in circumference. I was led to this remarkable sheet of ice by the "blink," having seen this atmospheric indication of its existence when in the open sea, at least thirty miles distant. In the year 1823, on the 29th of July, it is stated in my journal, that, "with a gentle breeze of wind from the southward, we traced the edge of a single field towards the north, from 9 A. M. till 4½ P. M., which was estimated to be thirty geographical miles in medial breadth. It was also very thick and heavy. *Places of several miles in area were free from hummocks.*" Along the edge of another field, on the same voyage, we coasted a distance of about forty miles. And again, under date of the 16th of July, (latitude 70° 48, longitude 19° 44′ W.), I find it recorded, that "we passed, in our progress through the floes, some remarkably fine smooth sheets of ice. On several of the heaviest floes, averaging, probably, twenty feet in thickness, there were occasional tracts of above a mile square on which there was not a single hummock. And one field had a space of about twenty-four square miles, (four miles by six by estimation), equally regular and even." This field, indeed, was so smooth, that I designed, had we remained near it a sufficient time, to have made trial of a *sailing-sledge*, respecting which I had given my carpenter orders; and I had no doubt of being able to traverse it by the mere force of a moderate breeze of wind.

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* Narrative, p. 98.

From these facts and observations, I think it must be quite evident, that the nature of the ice met with, in the recent experiment, must have been different from what it is on a more westerly meridian; and that this circumstance of itself prevented a fair chance of success. I shall not differ, however, in my views, from Captain Parry, as to whether it may prove to be "an easy task" to traverse the ice to the Pole. I know it would *not* be an easy task, and that it would not be found exempt from its peculiar hazards; but I still believe, from all we yet know of the polar ices, and from all the experience yet obtained, that the probability of reaching the Póle, notwithstanding the recent failure, remains unshaken, and that it is a project as feasable, and even much more so, than the discovery of a north-west passage *by sea*, and some other approved enterprizes.

To what has been already said in support of this conclusion, I may add one general argument, which will go far, I conceive, to support the whole of the grounds of reasoning which I had hitherto taken, and at the same time afford an independent proof that the failure of the recent experiment was not so much owing to difficulties inseparable from the enterprize, as to the defects or errors in the *plan* of the expedition. And this proof I derive from *what has been done* by other adventurers in travelling over ice of a similar nature to the ices of the Greenland Seas, under circumstances of equipment and support not at all equal to the advantages enjoyed by the expedition under Captain Parry. I refer to the expeditions of Alexei Markoff, of Lachoff, of Hedenstrom, of Sanniskoff, and of Baron Wrangel.

Markoff, according to Müller, with eight other persons, starting from the mouth of the river Jana, in the spring of the year 1715, performed a direct distance across the ice to the northward of 300 or 400 miles, (300 miles according to Captain Krusenstern), in light sledges drawn by dogs. Lachoff, a merchant of Jakutsk, with a single companion, went, in the beginning of April 1770, from the Swætoi Noss, above 100 miles to the northward upon the ice, by the same mode of conveyance; and early in May of the year 1775, the same adventurous person proceeded to Kettle Island and along shore, a distance, as measured upon the best charts, of at least 240 geographical miles. The manner of Sanniskoff's travelling, when he proceeded, on two or more occasions, 70 or 80 leagues to the northward of the coast of Siberia, I have not been able to ascertain; but I presume it was in sledges across the ice. Hedenstrom, however, who was sent out for research into the Icy Sea, by the enterprizing and liberal Romanzoff, made different extensive journeys from the entrance of the Jana to the coasts of New Siberia. In his first expedition, which was commenced in the month of May 1809, I do not find in what way he made his progress; but, in a subsequent expedition, in which he appears to have advanced about three degrees directly north, besides researches upon the coast of New Siberia, there can be no doubt but that his mode of proceeding was in sledges, as the adventure was accomplished in the winter season. And Baron Wrangel, who still more recently penetrated the Polar Sea from Skalatskoi Noss, travelled across the ice about 80 miles directly towards the north.

Now, it is worthy of remark, that all these journeys across the ice, and some others, the particulars of which I cannot ascertain, were performed either in the winter or spring of the year, when the ice was consolidated by the frost, and its continuity remained unbroken. They were all accomplished, not by a slow, but by a rapid progress; and the mode of performing the journeys was, in all cases I believe, in light sledges drawn by dogs*.

After such great success in similar enterprises by foreigners, it becomes a natural inquiry, why our adventurers, with all the advantages and admirable arrangements which the talent and liberality of the British Government could afford, accomplished so little? Why the different travellers alluded to accomplished a direct distance across the ice, one of 80 miles, another of 100, and afterwards of 240 miles; another more than once of 70 or 80 leagues, and another of between 300 and 400 miles, whilst our expedition completed only, *upon the ice*, a direct route of 72 miles? When most of the above adventurers accomplished *many leagues* a-day on ice, travelling without difficulty, why was it that our expedition, assisted by all that natural ardour so peculiar to British seamen, could seldom complete more than four or five miles a-day, directly across the ice (independent of currents), and sometimes, after the most laborious exertions, why were they able to advance only two or three miles within the twenty-four hours†? Surely it was not that our adventurers were less capable, less hardy, less enterprizing than others? To suppose it, would be to prove myself ignorant of the exertions that were made, unjust to the merits of the travellers, or prejudiced against an expedition that has failed of success. But there must have been some other cause or causes that affected the result; and these, I humbly submit, have been pointed out in the preceding remarks, as consisting chiefly *in the too great weight of the boats,—in the lateness of the season when the enterprize was attempted*, and, in another particular, which could not have been anticipated, that is, *the easterly meridian on which the experiment was made**.

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* The authorities from which these particulars, respecting journeys across the ice, were derived, are Müller's "Voyages," Cox's "Russian Discoveries," Burney's "Voyages to the North-East," Captain Krusenstern's "Notice sur les îles recemment decouvertes dans le Mer Glaciale," &c.

† It is mentioned in Captain Parry's Narrative of the expedition, that, on one occasion, after six hours of hard labour, they only got a mile and a quarter, and in the course of the day made but two and a-half miles northing! On another day they made but three and a-half miles N.N.W. in eleven hours! On another occasion they were two hours in getting 100 yards, and after a laborious day's work, made good only two miles and a quarter, including a lane of water of a mile and a quarter,—so that almost a whole day was occupied in passing over one mile of ice, independent of the action of the current!—(P. 70.)

Captain Parry, with whom I have the honour of being acquainted, having made respectable mention of my name and publications, in his "Narrative of an Attempt to reach the Pole," I felt considerable hesitation in offering these remarks, especially as there was no possibility of vindicating the plan originally submitted to the Wernerian Society, for approaching the Pole, without comparing it with the plan of the recent expedition. And I regret that these remarks have assumed (unintentionally and unavoidably indeed) the appearance of a criticism on Captain Parry's attempt; but it must be obvious to any one, that the object of this paper could not have been sufficiently accomplished without it. And that I ought, with the views I still hold of the practicability of the project, to attempt its vindication, I trust the introductory remarks to this paper, which were written some months ago, will justify; for it might naturally be said, that I considered the project of reaching the Pole, by a transglacial journey, as feasable, and proposed a plan for carrying it into effect; but as Captain Parry has attempted the project, and, on a plan in many respects similar, has failed, it must therefore be inferred that the undertaking is not practicable. Hence I am driven to the necessity, if I speak at all in my own vindication, of criticising the defects of the plan of the late expedition. And that I refer *only to the plan*, I conceive it justice to my own feelings, as well as to the persevering adventurers, explicitly to state; for I give full praise to the great and laborious, I may say astonishing, exertions that were made. And the surprise to me, considering the disadvantages under which they laboured, was, not that they accomplished so little, but that they were enabled to overcome so many difficulties, and to do so much.

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* It might be objected, as affecting this conclusion, that the less success of Captain Parry, than the other adventurers alluded to, might be owing to a difference in the state of the ice; but it may be sufficient to answer, that the difference in the season of the year, and state of the weather, were probably quite sufficient to account for any difference that might exist in the surfaces across which the parties respectively travelled.

LIVERPOOL,
21*st March* 1828.

Tables for Barometric Measurement. By Mr WILLIAM GALBRAITH, A. M. (Communicated by the Author.)

SIR, *Edinburgh, 3d April* 1828.

MY attention has lately been directed to draw up and collect a commodious set of tables for the barometric measurement of altitudes, as well as for the ordinary purposes of reducing the usual observations with the barometer. I need not inform you how rudely these are frequently made with the common barometer. This arises both from a bad state of the instruments employed, and the inadequacy of the corrections generally applied to reduce them to a standard point of temperature and level.

The accompanying tables, from which the necessary corrections, in all ordinary cases, may be taken out by inspection, are intended partly to remedy this inconvenience; and if you think them worth attention, perhaps you may give them a place in your useful and extensively circulated journal, so that they may be more generally known. I have carefully computed the first table from a formula of our distinguished countryman, Mr Ivory; and, of course, I have no other merit than the labour of computation. This I have executed for tubes varying in diameter from one-tenth of an inch to seven-tenths, to every hundredth of an inch, thereby including every variety of bore likely to be used. The second is merely an abridgment of one given by Schumacher in his Hülfstafeln. The application of those two will therefore give the absolute height of the mercury in the barometer reduced to the freezing point.

Example.—The height of the mercury of a barometer, with an adjustable cistern of a different bore from the tube, or with the usual cast-iron cistern corrected for capacity, and of 0.25 inch in diameter, was observed to be 29.564 inches, and the temperature 76° Fahrenheit, what is the height when reduced to the freezing point, or 32° Fahrenheit, when the expansion of the mercury only is applied, and when allowance for the brass scale, whose standard is 62° Fahrenheit, also is applied?

	Height.		Height.
	29.564		29.564
I. Capillarity to 0.25 inches,	+.041		+.041
II. Exp. for mercury only to 76°	—.130	Exp. for mercury and brass,	—.125
True height, -	= 29.475	True height, -	29.480

I am, Sir, your most obedient servant,
William Galbraith.

To Professor Jameson.

TABLE I.—Capillarity, or Depression of Mercury in Glass Tubes, to be added to the observed Height of the Mercury in the Barometer.

Diameter of Tube.	Capillarity.	Difference.	Diameter of Tube.	Capillarity.	Difference.	Diameter of Tube.	Capillarity.	Difference.
Inch.	*Inch of Mercury.*		*Inch.*	*Inch of Mercury.*		*Inch.*	*Inch of Mercury.*	
0.10	0.1404	146	0.30	0.0293	18	0.50	0.0082	5
0.11	0.1258	122	0.31	0.0275	18	0.51	0.0077	5
0.12	0.1136	103	0.32	0.0257	16	0.52	0.0072	4
0.13	0.1033	90	0.33	0.0241	15	0.53	0.0068	4
0.14	0.0943	78	0.34	0.0226	14	0.54	0.0064	4
0.15	0.0865	70	0.35	0.0212	13	0.55	0.0060	4
0.16	0.0795	62	0.36	0.0199	13	0.56	0.0056	4
0.17	0.0733	55	0.37	0.0186	11	0.57	0.0052	3
0.18	0.0678	50	0.38	0.0175	11	0.58	0.0049	3
0.19	0.0628	45	0.39	0.0164	10	0.59	0.0046	3
0.20	0.0583	41	0.40	0.0154	9	0.60	0.0043	2
0.21	0.0542	38	0.41	0.0145	9	0.61	0.0041	3
0.22	0.0504	34	0.42	0.0136	9	0.62	0.0038	2
0.23	0.0470	32	0.43	0.0127	8	0.63	0.0036	2
0.24	0.0438	29	0.44	0.0119	7	0.64	0.0034	3
0.25	0.0409	27	0.45	0.0112	7	0.65	0.0031	2
0.26	0.0382	24	0.46	0.0105	6	0.66	0.0029	2
0.27	0.0358	24	0.47	0.0099	6	0.67	0.0027	2
0.28	0.0334	21	0.48	0.0093	6	0.68	0.0025	1
0.29	0.0313	20	0.49	0.0087	5	0.69	0.0024	

TABLE II.—Reduction of the English Barometer to 32° Fahrenheit, or to the Freezing Point. Subtractive.

Temperature Fahr.	Part I.—For Mercury only.				Part II.—For Mercury and Brass.			
	Height of the Barometer in Inches.				Height of the Barometer in Inches.			
	28 Inches.	*29 Inches.*	*30 Inches.*	*31 Inches.*	*28 Inches.*	*29 Inches.*	*30 Inches.*	*31 Inches.*
32°	0.0000	0.0000	0.0000	0.0000	0.0088	0.0091	0.0094	0.0097
34	0.0056	0.0058	0.0060	0.0062	0.0138	0.0143	0.0148	0.0152
36	0.0112	0.0116	0.0120	0.0124	0.0188	0.0194	0.0201	0.0208
38	0.0168	0.0174	0.0180	0.0186	0.0238	0.0246	0.0255	0.0263
40	0.0224	0.0232	0.0240	0.0248	0.0288	0.0298	0.0309	0.0319
42	0.0280	0.0290	0.0300	0.0310	0.0338	0.0350	0.0362	0.0374
44	0.0336	0.0348	0.0360	0.0372	0.0388	0.0402	0.0416	0.0430
46	0.0392	0.0406	0.0420	0.0434	0.0438	0.0454	0.0470	0.0485
48	0.0448	0.0464	0.0480	0.0496	0.0488	0.0506	0.0523	0.0541
50	0.0504	0.0522	0.0540	0.0558	0.0538	0.0558	0.0577	0.0596
52	0.0559	0.0579	0.0599	0.0619	0.0588	0.0609	0.0630	0.0652
54	0.0615	0.0637	0.0659	0.0681	0.0638	0.0661	0.0684	0.0707
56	0.0671	0.0695	0.0719	0.0743	0.0688	0.0713	0.0738	0.0762
58	0.0727	0.0753	0.0779	0.0805	0.0738	0.0765	0.0791	0.0818
60	0.0783	0.0811	0.0839	0.0867	0.0788	0.0817	0.0845	0.0873
62	0.0838	0.0868	0.0898	0.0928	0.0838	0.0868	0.0898	0.0928
64	0.0894	0.0926	0.0958	0.0990	0.0888	0.0920	0.0951	0.0983
66	0.0950	0.0984	0.1018	0.1051	0.0938	0.0971	0.1005	0.1039
68	0.1005	0.1041	0.1077	0.1113	0.0988	0.1023	0.1058	0.1094
70	0.1061	0.1099	0.1137	0.1175	0.1037	0.1075	0.1112	0.1149
72	0.1117	0.1156	0.1196	0.1236	0.1087	0.1126	0.1165	0.1204
74	0.1172	0.1214	0.1256	0.1298	0.1137	0.1178	0.1218	0.1259
76	0.1228	0.1271	0.1315	0.1359	0.1187	0.1229	0.1272	0.1314
78	0.1283	0.1329	0.1375	0.1421	0.1237	0.1281	0.1325	0.1369
80	0.1339	0.1387	0.1434	0.1482	0.1286	0.1332	0.1378	0.1424
82	0.1394	0.1444	0.1494	0.1544	0.1336	0.1384	0.1432	0.1479
84	0.1450	0.1502	0.1553	0.1605	0.1386	0.1435	0.1485	0.1534
86	0.1505	0.1559	0.1613	0.1667	0.1435	0.1486	0.1538	0.1589
88	0.1561	0.1616	0.1672	0.1728	0.1485	0.1538	0.1591	0.1644
90	0.1617	0.1674	0.1731	0.1790	0.1535	0.1589	0.1644	0.1699
P. P. Temp. +	0°.4 12	0°.8 24	1°.2 35	1°.6 47	0°.4 10	0°.8 21	1°.2 31	1.°6 42

A Short Sketch of the Geology of Nithsdale, chiefly in an Economical Point of View, and contrasted with that of the Neighbouring Valleys. By JAMES STEWART MENTEATH, Esq. Younger of Closeburn, Member of the Wernerian Natural History Society. (Concluded from page 323 of last Number).

THE strata of the limeworks at Closeburn, are divided by the workmen into upper and lower posts; and, in considering them, it may not be improper to retain these names.

The upper post of limestone is 14 feet thick, being contained between two impure strata of limestone, called, by the workmen *dogger*. The lower post is about 18 feet thick. The upper post, with strata of sandstone and clay, overlies the lower post. Both these two posts of limestone seem, from appearances, to extend from the present workings of Closeburn across the southern end of the Basin of Closeburn to Barjarg, on the west side of the Nith. But the uniformity of their continued inclination is interrupted by a throw-down or dislocation of the strata. This is to be observed, at the New Kiln, situated at the south-west of the present workings.

In consequence of the great expence of removing the cover from the upper post of limestone, and likewise from a quantity of magnesia which it contains, little of this post is used. About forty years ago, specimens of this, and of the lower post, were analysed by the late celebrated Dr Black of Edinburgh; but from the imperfect method of analysis then known, the presence of magnesia was not detected in the upper post. But when this upper post was analysed a few years ago by the late ingenious Dr Murray, it was found to contain in 100 parts, 42 parts of carbonate of magnesia, and 54 of carbonate of lime. When it is calcined, it makes an excellent cement.

Occasionally in this upper post cavities are observed, and are often found filled with the black oxide of manganese.

The lower post is nearly 18 feet below the upper, and separated from it by strata of sandstone and clay, having, however, the same dip as the upper. It is about 18 feet thick, and is the pure carbonate of lime, ascertained by Dr Murray's analysis to consist in 100 parts of 91 of carbonate of lime, equivalent to 50 of pure lime. In this lower post, are several small beds of clay or stone marl, containing 10 per cent. of carbonate of lime, with impressions of shells, and alternating with beds of limestone, which have imbedded in them some very interesting organic remains, several of which have been drawn and described by Sowerby in his Mineral Conchology. The following are the most curious:—Orthoceræ, nautili, some spiral shells, producti, trilobites, and corals. The knowledge of such petrifactions has become more interesting, since it has been ascertained by Mr Smith, the ingenious author of a Mineralogical Map of England, that they may be often a means of identifying strata. Advantage has been taken of these clay-beds to mine the lower post of limestone. For some years the operations of this mining have been extensively carried on, and these excavations now exceed many hundred square yards. In proceeding with these excavations, strong pillars of nearly 6 square yards in thickness are left standing, as supports for the roof of the mine, which is high enough to admit the miner to stand erect at his work; and between the pillars the space of 30 feet is excavated. This limestone, which is of a reddish colour, being extremely compact, requires the aid of gunpowder in working it. The heart of these excavations is penetrated by an iron railway, laid upon an inclined plane, up which, to the top of the kiln, the limestone is raised by a water-wheel; and this way of working has been for several years adopted at Closeburn Lime Quarry.

The great advantage of a command of water in carrying on the operations of an extensive work, is here strikingly exemplified. Having put in motion the machinery which draws the waggons loaded with limestone up the inclined plane, the water is made to pass on in a channel excavated in a clay bed, and descending to a lower level, is made to fall upon another wheel, which puts in motion the pumps that drain the mine, and at the same time a mill for sawing timber. The water, after these useful applications, is next conveyed away for irrigation.

It is worthy of remark, that the clay-bed, in which the water-channel is cut, is well adapted for making fire-bricks. The kilns at Closeburn Works for burning lime, are lined with the bricks made of this clay; and they resist, without injury, for a long time, the great heat to which they are exposed.

On account of the distance from coal, great pains has been taken in economizing fuel at these lime-works, by contriving such a form of kiln that will produce in a given time the greatest quantity of well calcined lime, with the smallest possible quantity of fuel.

The kilns employed at Closeburn Works are built on the side of a hill, and they are of two forms, the circular and the oval.

The circular kiln has cast-iron doors to the fuel chamber and ash-pit, and a cast-iron cap or cover, which, turning on a pivot, and resting on a curb-ring fixed on the top of the masonry of the kiln, can be put on or off the top of the kiln when required. This iron cover, having a chimney 12 inches in diameter, fitted up with a damper, prevents the escape of heat at all times; and when the country sale is irregular, keeps the fire from going out, by being kept close, as well as the doors below. One of these circular iron-topped kilns will deliver daily, of well calcined lime, $\frac{3}{4}$ths of its contents.*

Closeburn lime-work receiving its fuel from a great distance, 25 miles or more, it is found to be a considerable saving of carriage to coke or char the coal at the pit. A measure of this coke burns as much as the same measure of coal, but is used only in this kind of kiln.

The oval kiln varies somewhat in its proportions from the circular. The oval form has been found preferable, when coal is the fuel employed. It is built in a similar situation with the circular. It has windows to the fuel chamber, and ash-pit and an arched cover formed of an iron frame filled up with brick, with a chimney, the whole moving with wheels on a railway; and by means of windlasses, it can be drawn off or on the top of the kiln.†

From this oval kiln $\frac{3}{5}$ths of its contents may be drawn out daily; and when it is closed at top and bottom, the fire will not go out for five or six days.

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* Of the circular, the following are the proportions:—It is circular within, 32 feet high from the furnaces, 3 feet diameter at top and bottom, and 7 feet diameter at 18 feet from the bottom.

† The height of this oval kiln is 35 feet, the short diameter at the fuel chamber is 22 inches; and, at the height of 20 feet, the short diameter is gradually extended to 5 feet, and is so continued to the top, where the oval is 9 feet by 5 feet. And having a broad fuel chamber, it requires three separate doors or openings more speedily to draw out the lime.

The lime-quarry at Barjarg, on the other side of the Nith, is worked, not by mining, but by removing the cover from the rock; and is of course done at more expence. The kilns are here of the common kind, without iron-covers or iron-doors for the grates. The lime-quarry at Closeburn has been opened and worked for above fifty years.

It is curious to observe how much prejudice often opposes useful improvements. When these limeworks were opened in 1772, so general was the opinion of the injurious consequences of lime laid on land for agricultural purposes, that the proprietor, in order to introduce its use, obliged his tenants, in their leases, to lime a certain quantity of land yearly, he furnishing the lime, and even paying for the carriage; and the tenants on their parts, were bound to pay 5s. additional rent for every 80 measures of lime, the quantity considered sufficient for an acre. Notwithstanding, however, this liberal encouragement to the tenant, the greatest quantity of ground he would be induced to lime, was only two acres in the year; and some could hardly be prevailed on at all to make the experiment. But experience has surmounted this prejudice, and no inducement is any longer required. Its effects on the appearance of the country are most striking. When the present proprietor of Closeburn came into possession little more than 30 years ago, the country around these lime-works, to a considerable distance, was covered with heath, barren, and unproductive. By judiciously, however, applying lime as a top-dressing, the heather has gradually disappeared, and has been replaced by good herbage. The effects of this lime-quarry, and that of Barjarg, may be seen all over the Basin of Closeburn, and in the adjoining Basins of Sanquhar, Glencairn, and Dumfries; and even much farther, as into some parts of Galloway, distant 40 miles from these works, for in neither of the districts of Galloway has lime hitherto been found.

Not far distant from Closeburn lime-works, on the same side of the Nith, are two small basins of limestone, which appear unconnected with it. That which is found at the Shielgreen is interesting, as it presents a vitrified appearance. It is not a pure limestone, but contains a portion of sand. The other occurs at the Linburn; and though also very impure, differs from that of the Shielgreen.

The soil of the basin of Closeburn varies very much, partaking somewhat of the character of the strata which it covers. The soil nearest to the greywacke is clayey and tenacious, requiring much drainage, and much lime. Its improvement, after these operations, is rapid and astonishing. Much of the interior of the surface of the basin is thrown up into small risings or eminences, and the soil of all these is invariably of a water-worn, rounded, pebbly gravel. This kind of soil requires no little expence and exertion to render it productive. But the numerous hollows intervening between these gravelly hillocks, are frequently filled with peat-moss, of which the industrious husbandman has availed himself, in many instances, to make into compost with lime, and strew over those gravelly grounds. And by these means, and by cultivating the turnip, and feeding them off with sheep, he is enabled to reap heavy crops of grain from these light gravelly tracts of this basin.

There is a narrow tract of soil, though pretty extensive, moorish, and filled with white round pebbly stones, which is the very worst of all the soils in the basin of Closeburn, and is with great difficulty rendered productive.

There is a considerable extent of land in this basin covered pretty deeply with peat. In reclaiming this soil on the estate of Closeburn, the improvements have been attended with the most gratifying success. A variety of grasses have been cultivated on these peat soils, but non have succeeded so well as the *Holcus lanatus*, or soft grass, or Yorkshire fog. Its seeds being produced in immense quantities, can be procured at a cheap rate. The peat land in the course of cultivation is generally found to be too little tenacious, and is apt, if sown with grain crops, to injure much the succeeding grass. In these improvements on the estate of Closeburn, all grain cultivation has therefore been most carefully avoided. As soon as the peat-soil is prepared by proper pulverization, by ploughing and harrowing, it is then sown with the *Holcus lanatus*, whose innumerable roots and far-spreading leaves, soon cover over and restore a tenacity to the soil. With this grass the clover grows admirably well.

All the varieties of soil, however, of the Closeburn basin are improved by lime; and whenever larger doses of it are laid on the soil, and a better system of husbandry generally pursued, very great improvements may be expected in the general aspect of the whole surface of the district.

It may be worth while, as connected with the subject of soil, to mention some curious facts respecting the growth, toughness, and durability of different kinds of wood in the basin of Closeburn, and which may perhaps be looked for in other districts of Scotland similarly circumstanced.

The Scotch fir, *Pinus sylvestris*, thrives well, but does not grow fast on the soil over the sandstone. Its wood, however, is tough and very durable. But when this same tree is planted on the greywacke, though it grows more rapidly, and arrives sooner at maturity, yet being softer and fuller of white wood than that grown upon the sandstone, the builder, to his cost, finds that it is soon attacked by the worm, and decays *.

The reverse of this happens with the Larch, *Pinus Larix*, when growing on the greywacke. Its wood is sound and good, and, when cut down, is at heart quite perfect. But on the sandstones and gravels of this basin, it seems to be at maturity at an earlier age than that growing on the greywacke, and, in many instances, when cut down on these soils, the larch presents a tubed, decayed heart. Under twenty years old such instances of internal decay appear. And the remarkable thing is, that externally to the eye the larch seems healthy and vigorous.

We may here state that the larch grows naturally only on the primitive mountains, as the granite, gneiss, and the like rocks of that class of the Alps, in Switzerland. And it is most curious to observe, that, on the whole range of the Jura mountains, separating that country from France, and being a limestone formation, rising to an elevation of several thousand feet, not a single self-sown larch can be discovered.

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* Some remarkable facts respecting the durability that may be given to timber by artificial means, have been observed at Closeburn. The proprietor of that estate has for thirty years been in the constant practice of soaking all fir and larch timber, after it is sawed into plank, in a pond or cistern of water, strongly impregnated with lime. In consequence of this soaking, the saccharine matter in the wood, on which the worm is believed to live, is either altogether changed, or completely destroyed. Scotch fir wood, employed in roofing of houses, and other indoor work, treated in this manner, has stood in such situations for thirty years, sound, and without the vestige of a worm. In a very few years, fir timber so employed, without such preparation, would be eaten through and through by that insect. It might perhaps be advisable, in all timber used for ship-building, to soak it for some days in lime-water.

Advancing, however, from this range into Switzerland, it may be observed, that, in those places, as at Chamounie, Mount Cenis, the Simplon, and the lofty Alps, which partly inclose the beautiful lake of Thun, in the canton of Berne, where the primitive formation, consisting of granite, gneiss, mica-slate, and similar rocks, abounds, the larch is indigenous, growing luxuriantly, and attaining to a great size. Almost at the summit of the Simplon, upwards of 6000 feet of elevation above the sea, instances are met with of larches of 16 feet in circumference at some distance from the ground.

Connected with the same formation, are the largest larches found in Scotland, as at Dunkeld. One of the largest of these trees measures 18 feet in circumference; and they are of no great age, for it was only in 1738 that they were brought from the Alps, and planted at Dunkeld. From the progress they have made, and their present thriving appearance, it is probable they will attain a great age.

The durability of the larch throughout Switzerland is proverbial; and in all situations where exposure to weather must be encountered, such as roofing of houses and the like, recourse is always had to larch. It is said that the piles on which Venice is built are of larch wood. It would thus appear, that the greywacke approaching very near in qualities to the primitive mountain soil, is the best qualified to grow the larch; and in Nithsdale the larch ought only to be planted on the greywacke, as is evidently proved by experience in the Basin of Closeburn.

While enumerating the mineral productions of this basin, we must not forget to mention its mineral springs, although these are neither numerous nor important. In some places, chalybeate waters are found, and have been used, to considerable advantage. Near the Castle of Closeburn, issuing from a peat-moss, now improved, is a sulphuretted hydrogen spring, and another at no great distance, which have sometimes been resorted to with good effect in cutaneous complaints.

Basin of Dumfries.—The Basin of Dumfries, the last of those that form Nithsdale, is separated from that of Closeburn, by a considerable ridge of greywacke, nearly five miles in breadth. Through this ridge the Nith finds itself a passage, and enters the Basin of Dumfries. This Basin is open on the south, and is there bounded by the Solway Frith; but on the east, north, and west, is encircled by the greywacke, except at the south-east, near Mousewald Kirk, where it unites itself to Annandale.

The greywacke hills, which partly surround the Basin of Dumfries on the east, north, and west, are of lower elevation than those of Closeburn, and of much less pleasing forms. They are green, and cultivated to their summits; but produce fewer streams than the three preceding Basins. Of these, the only one of any note falling into the Nith below Lincluden Abbey is the Cluden. In its long, pleasing, and winding course, it passes through the parish of Glencairn, a pretty wooded sequestered basin. The whole of it, as well as its encircling mountains, are greywacke, separating it from those of New Cumnock, Sanquhar, and Closeburn. The Lochar, a detached and independent stream, in its way to join the Solway at Carlaverock, passes through an extensive peat-moss,* which, by its broken, black, swampy appearance, casts a gloom on all the beautiful scenery of the lower part of the Basin of Dumfries.

The interior of the basin of Dumfries is filled entirely with the *New red sandstone*, for as yet no traces of the white or grey have been observed. This red sandstone is much softer, and decays more rapidly by exposure to the weather than that of Closeburn. At Lochar Bridge, and at Castle Dyke quarries, where this red sandstone is raised, proofs may be seen of its decomposing nature †. On the west side of the Nith in Galloway, to the south of Griffel, which is sienite, near Arbigland, the coal formation appears; but the strata are so much on their edge, and so insignificant in their thickness, that they are of no value. It is very probable that the Solway Firth is a great coal basin, for coal is worked on the English side, as between Workington and Whitehaven; and on the Scotch side the strata of the coal formation (coal metals) shew themselves.

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* In it often are found the bones and horns of a large species of deer.

† At the latter place, the mineralogist will find imbedded in the red sandstone, curious specimens of basalt, and other rocks of that kind, some of them exceeding the size of a man's head.

No limestone has been discovered in the basin of Dumfries. A little beyond its south-eastern extremity, as at Camlongan, the limestone appears, but coarse and bad in quality. The farther, however, we penetrate into Annandale, in its lower district, it becomes better and more abundant.

Of the ores, no traces have hitherto been met with in the basin of Dumfries.

Here, as in the valley of Closeburn, the greywacke decays into a soil which is a cold and stiff clay, requiring lime to loosen, pulverise, and fit it for the growth of herbage. Not much, however, of this kind of soil occurs in this basin, for the greater part of it resting on the red sandstone, partakes of those qualities that are usually observed in red sandstone districts. The soil is generally light and gravelly. It requires much manure and good husbandry to make such a soil productive. On the western slope of the Tinwald greywacke hills, the soil is rich, deep, and loamy, and may perhaps be considered the best tract of soil in the basin of Dumfries.

It is a great hindrance to the more improved cultivation of the basin of Dumfries, that no limestone has been found in it; all that is required for agricultural and building purposes being either imported from Cumberland, or brought from Closeburn or Barjarg limeworks, or Kellhead, in Annandale.

Thus we have pointed out a few of the most striking mineralogical appearances, including those of soil, in the four basins of Nithsdale, and we have found that each has some peculiarity. The basin of New Cumnock, abounding in coal and limestone, though at a considerable elevation, and with a strong, cold, adhesive clay soil, is cultivated almost to the summits of the hills, and inhabited by an industrious, active population, who have availed themselves of their natural advantages, and have turned their attention and capital to collect large dairies, which yield them ample returns in butter and cheese. It cannot be doubted that these improvements have, in a great measure, resulted from, and been fostered by, the abundance and cheapness of lime, in which this basin abounds. While, on the other hand, the Sanquhar basin, although it is lower, and consequently with a more favourable climate, and in possession of coal for all its necessities, yet, being deprived of limestone, and obliged, at much expence, to import it from other quarters, it has been retarded in its improvements, and is inferior, in respect to extent cultivated, and its condition, to that of New Cumnock.

But the basin of Closeburn, without a particle of coal, yet having within itself at its southern extremity, as at Closeburn and Barjarg, an ample deposit of excellent limestone, has made rapid strides in the improvement of its soil, and must and will proceed much farther. Many and most striking evidences on the estate of Closeburn are before the eye, of the astonishing and cheering alterations which lime, laid on in great quantities, makes on the face of a heathery and barren tract of country.

Even the basin of Dumfries, deprived of either coal or limestone, has, by good communications by land, and by improvements in its river navigation, been enabled to remedy, in some degree, its want of a limestone deposit; and will not be outdone by the natural advantages of the three higher basins of the Nith.

It may not here be unworthy of remark, and may appear not a little extraordinary, that, in situations so similar as the basins of New Cumnock, Sanquhar, and Closeburn, we find coal and lime in abundance in one, coal only in another, and lime alone in a third. What process could be going on in these different basins, so as to afford this difference of products, geology has not yet perhaps advanced sufficiently far to enable us to attempt any satisfactory explanation.

Having now, as far as we have been able, given an account of a few of the remarkable geological appearances of the four basins of the Nith, or of Nithsdale, it may not be uninteresting to take a hasty glance of the other two districts into which Dumfriesshire is naturally divided, viz. Annandale and Eskdale, in order that we may be able to draw a comparative view of the natural advantages of the three great districts of this county.

Basins of the Annan.—The first of these, Annandale, may be divided into the Upper and Lower Basins. The upper is separated from the lower basin by a narrow ridge of amygdaloid rock, which runs across the Annan at the Manse of St Mungo, uniting the Tinwald greywacke range of hills with those on the eastern bank of the Annan, and may be traced skirting the greywacke mountains from Burnswark to Langholm. This rock seems to cut off the new red sandstone of the Upper and Lower Basins; but as it has been bored in several places, and the red sandstone always found under it, we may infer that the red sandstone extends from the one basin to the other, and is merely covered by this formation, or probably the amygdaloid intersects the sandstone.

The greywacke mountains which shut in this upper basin of the Annan are lofty, and to the north present a bold picturesque outline. Their sides slope to the Annan, and afford good pasturage to numerous flocks of sheep. In this upper basin, the wood, from something unfavourable in the soil, is scanty, and does not appear to grow luxuriantly. About Raehills, the spruce fir is that which grows best. On the west, the Annan is joined by the streams of Evan, Ae, and Kinnel; on the east, by the Moffat, Whamphry, Dryfe, and the Milk, all proving, by the number of the streams issuing from these mountains, their great elevation.

The interior of this upper basin of the Annan is filled with the new red sandstone. This red sandstone is well fitted, from its compact texture, for all kinds of building.

Neither limestone nor ores of any kind have hitherto been met with.

A mile from the town of Moffat, resorted to for its medicinal waters, there is a sulphuretted hydrogen spring, issuing from a greywacke rock, containing iron pyrites, and passing through a peat-bog, where it is probably still more impregnated with sulphur.

About five miles from Moffat is Hartfell Spa, which is a strong chalybeate. It issues from a rock of alum-slate on the side of the mountain of Hartfell.

These springs have caused great resort to this district, and have thus as it were created the interesting village of Moffat, and contributed to the improvement of the neighbouring country.

The soil of this upper basin of the Annan, consists in part of a stiff, tenacious clay, which may be probably owing to the number of streams constantly wearing away the greywacke mountains, and carrying their debris into the basin. The soil on some of the more level parts, as on the banks of the Annan, is a fine rich alluvial loam, productive of all kinds of grain.

To the south of the Manse of St Mungo, the lower basin of the Annan commences, and expands itself a considerable way towards the Solway Firth. On the west it unites itself to the Basin of Dumfries; and to the east, to the lower basin of the Esk. The Milk and the Mein are the principal streams that join the Annan in its course southwards.

The sandstone which prevails is the *new red*, which appears nearly to cover all the other strata, except in some places, as at Cove Quarry, on the banks of the Kirtle, where the light ochry sandstone bursts up from under it. At Kilhead, the limestone, being in some places overlaid by an impure limestone, of 30 feet thick, and upwards, is quarried and burned. Its thickness is about 30 feet, and it is said to yield 95 parts out of 100, of carbonate of lime.

From several appearances of the strata, where sections can be had (as in several places of the Kirtle, a beautiful wooded stream, which flows into the Solway, more to the south than the Annan), indicating strongly the presence of coal, it is probable that that valuable mineral may be discovered; but whether in beds of sufficient thickness to repay the expence of working, cannot be ascertained till farther trials be made; and, indeed, from late attempts that have been undertaken in this quarter, it seems very doubtful *.

The soil of this lower basin of the Annan partakes very much of the characters of that usually occurring in coal districts. It is a stiff, adhesive clay; has great tendency, from its retentiveness of moisture, to produce the rush; but, as this basin abounds in limestone, the means are at hand to obviate some of the defects of a clay soil.

Basin of the Esk.—The river Esk, in its course from its source to the Solway Frith, flows through two basins, an upper and a lower. It is difficult to distinguish the lower basin of the Esk from that of the Annan. They run so much into one another, that a better division of this lower district of Dumfriesshire would be, to consider the two as one large basin. The mountains which form the sides of the higher parts of Eskdale are high, having extensive grassy slopes, that yield to large flocks of sheep an excellent pasturage. From its source to Langholm, the Esk, joined by the Meggot and the Ewes, runs in a very straitened basin, which may be called the Upper Basin of the Esk. This basin contains neither coal, lime, nor sandstone throughout its whole extent, the prevailing rock being greywacke. At Glendinning, the greywacke rock contains *grey antimony-glance*, or *sulphuret of antimony*. Some years ago it was mined to advantage, but the workings are now abandoned. In the same neighbourhood, among the mountains, there are traces of *galena* or *lead-glance*.

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* From the favourable appearances, however, of the strata, it seems probable that coal may be found in the Springkell estate.

Below Langholm, the basin of the Esk expands; and, to the west, unites itself with the Lower Basin of the Annan, which may be called the Lower Basin of the Esk. This basin contains mountain limestone, the coal formation, and the new red sandstone. These deposits, according to Professor Jameson, are arranged in the usual order, the mountain limestone being the lowest; next the coal; and, resting upon the coal, in several places, the new red sandstone. On the Byreburn, below Langholm, the coal is worked, though no seam exceeding 3 feet has been discovered.

From Langholm, in the direction of Ecclefechan and Brownmuir, limestone is found in all that range; and beyond, to the north of this line, the greywacke.

The soil of the lower basin of the Esk is similar, in all its character and qualities, to that of the lower basin of the Annan.

Having thus hastily and rapidly sketched the districts of Annandale and Eskdale, and, as briefly as we could, enumerated their mineral deposits, it may not be uninteresting to contrast them with Nithsdale, which forms the principal subject of this sketch.

In the upper basin of the Annan, we have observed that there is neither coal nor lime; that its distance from those districts where these minerals abound, has checked its advancement in improvement. The upper basin of the Esk, without coal, limestone, or sandstone, is still more unfavourably situated than that of the Annan, and its improvement must be necessarily more retarded. But in the lower basins of the Annan and the Esk, the former abounding in limestone, and the latter with both limestone and coal, though hitherto sufficient advantage has not been taken of these things; yet it is to be expected that the stiff cold tenacious clays that cover so large a tract of these basins, will be ultimately improved and rendered much more productive, when greater quantities of lime are employed in agriculture.

Although the upper basins of the Esk and the Annan are behind those of the Nith in mineral treasures, and in improvements, yet, if the local advantages of water, every where so abundant in these two districts, were embraced, it may be presumed that the want of limestone might, in some degree, be compensated: For these two basins, shut in on all sides by lofty greywacke mountains, abound in streams which offer great facilities for irrigating the flat lands of the basins. By this irrigation, and the raising of great additional quantities of hay, the numerous flocks fed in these districts, which are often, in the severe storms of winter, and in the dry cold springs, driven to great extremities for food, would be abundantly supported; and it is probable that, by these means, the stock might be greatly increased. The efficiency and successful application of water in flooding meadow or low lands, and thereby augmenting their annual produce in either grass or hay, has been clearly demonstrated by what has been done on the Closeburn estate in Nithsdale *. Its proprietor, sensible of the infinite value of water for meadow lands, has, at much cost, engineered a water-course of seven miles in length from the greywacke hills on the east of the basin of Closeburn; and, in another direction, another course of equal length, which collects, in their passage, every rivulet that descends from the hills. These two canals are made to irrigate an extensive tract, producing a large increase of food, often upwards of 400 stones of hay per acre, being nearly twice as much as these grounds formerly yielded. These successful applications of water-flooding for meadow lands, afford a strong presumption, where the climate and soil are very similar, that this

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* This instance of the advantage of irrigation has been given as most familiar to the author, though many others are to be found in Scotland.

plan might be applied with advantage in the upper basins of the Annan and the Esk.

But the great advantages which Nithsdale derives from its minerals may be more fully seen, by comparing it with the neighbouring valley of the Dee, which forms the greater part of the county of Kirkcudbright. This valley, in its longest branch, that of the Deugh, commences nearly at the source of the Nith; runs almost parallel to that district, and is much of the same length. It does not rise to a greater height above the level of the sea, and may therefore be supposed not to differ much in climate; and the soil is, we believe, not inferior.

But when we compare the two districts with each other, we find a striking difference. Nithsdale, as we have seen, has abundance of limestone, coal, and sandstone, extending almost to the source of the Nith, admitting of houses being built well and cheaply, fuel being had at a trifling expence, and the land cultivated almost to the tops of the hills. But in the Valley of the Dee, in Kirkcudbrightshire, there is neither coal, lime, nor sandstone; and we find in that tract, nearly the whole upper part of it, almost waste. No village occurs exceeding a few houses, and these indifferently built; the land, from want of lime, is uncultivated, and laid out mostly in extensive sheep farms; and there is little hay except what is naturally produced for rearing of cattle,—an evil which might probably be, in some degree, remedied by the use of irrigation, as already suggested in regard to the upper districts of Dumfriesshire. There are, however, none of those mineral substances which give employment, and create a population to consume the produce of the soil, and promote the industry of the farmer.

Thus are these two districts in Galloway and Dumfriesshire, in several respects, similar as to situation, soil, climate, and extent, but widely different in improvement and population; and this difference arises chiefly from the superiority of the one over the other in mineral treasures. Nor is it to be thought that Nithsdale has, from its minerals, yet derived all the advantages of which it is capable.

It is not much above half a century since the roads in Nithsdale were passable for heavy carriages. Many of them were little better than horse-tracks; nor are they yet, in the basin of

New Cumnock, at all good, and fitted for the conveyance of great weights, even for the single horse cart. It may therefore be expected, that great improvements will still be made, when the roads are better directed, or railways, which are now proposed, and even actually surveyed *, have been introduced, so as to render communication easy, and the resources of the different parts of Nithsdale available for the general use.

And when mineralogy, a science so interesting to the philosopher, comes to be more generally understood and applied to the discovery of useful mineral substances, we may expect that this tract will furnish products not yet brought to light, which may contribute to promote agricultural and manufacturing industry; and that the Valley of the Nith, though not the most extensive, may become one of the most important that is any where to be met with in Scotland.

On the most effective Employment of Steam Power in maintaining a Ferry. By Captain ALEXANDER McKONOCHIE, R. N. Communicated by the Author.

THE superiority of steam over wind as a *prime-mover*, is sufficiently recognised in almost every department of art; and wherever the manufacture will defray the additional expence, almost without exception the first has driven out the last. In maintaining ferries, however, this superiority has been more fully admitted, perhaps, than in any thing besides;—the uncertainty of sailing boats, now ten minutes and now an hour in making the same passage—the number of piers to which they must ply, according to circumstances of wind and tide with which the public cannot be acquainted—and the cold, wet, alarm, and even positive danger, to which passengers on board of them must occasionally be subjected,—being all evils which no perfection of management can even palliate; and which have been so much more impatiently borne as a better means of transport has become better known, that in modern phraseology, the *improvement* of a ferry, and the substitution of steam for sailing boats on it, have become nearly synonimous and convertible terms. There are two ways, however, in which steam may be thus employed, and it would be interesting to determine which of them is the best. An engine may be embarked in a large boat, fitted to receive passengers and goods; and this method has exclusively been adopted, as yet, in this country. Or it may be embarked in a tug-boat, and employed to tow over large passage vessels, given up entirely to the reception of freights. It is believed that this last is very much the better way; and it may be observed, as presumptive evidence of this, that it has lately been introduced on a great scale, and as a great improvement, in America. All the reasons, however, for thinking so, have not yet been brought together on paper; nor the subject, consequently, been considered in the detail which its importance seems to merit. And an attempt to do this will now therefore be made.

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* Report relative to the proposed Railway from Dumfries to Sanquhar, by Robertson Buchanan, made in 1811.

It may be proper to premise, that the precise system thus brought under consideration is the following: Two tug-boats of great power to be kept; and several, perhaps on a principal ferry as many as six, decked passage vessels of different sizes, but all properly equipped for the comfortable accommodation of passengers, horses, carriages, &c. The first to be plied, one at a time, unless when extraordinary circumstances of weather or passage require both; the last to be used, one or more, large or small, as the same circumstances may direct. And the following are the principal reasons which at present occur in favour of such an establishment.

1. Its superior economy to any thing yet devised is very striking. A large steam-boat, with a powerful engine, cannot be constructed much under L. 4000; the Dundee boats cost L. 4500; the Burntisland ones, I believe, above L. 5000; and, if one is kept constantly plying, there must be two; if two, there must be three, to constitute an efficient establishment anywhere. But the best steam-tugs need not cost above L. 2000, nor passage vessels above L. 300 each; so that two of the first, and several of the last, would not, all together, much exceed *one* of any of the above boats. And that they would be more

efficient than even a full establishment of them, can, it is believed, be as satisfactorily shewn.

2. The system under consideration would enable the managers of a ferry to proportion their accommodation, at all times, to the exact demands of the passage. One steam-boat, as usually constructed and employed, is too little for any ferry. Even two may be occasionally insufficient; while, in general, they may be more than is wanted, and the expence of plying them may not thus be defrayed. A steam-tug, however, will tow over one, two, or more passage vessels in ordinary circumstances; and if, at any particular time, the work exceed its powers, the passage must then be so frequent as to defray the expence of working a second tug. And it should be observed, that two corollaries flow from this quality in the new system, each in its way interesting, if not both equally so. 1. Unnecessary wear and tear would be thus avoided. 2. Managers being thus enabled to extend their accommodation, almost at will, without additional expence, would also be enabled to favour any particular local interest without sacrifice. Agricultural produce, for example, of which the chief articles are bulky, and yield but a small profit, while their free circulation is of importance to all classes, might well claim to be thus every where distinguished. And most localities have something or other besides, which they might desire in like manner to encourage.

3. By enabling managers to diminish their incumbrances, according to the state of the weather, this system would also *virtually* enable them to increase their power, according to the same state. In moderate weather, a powerful tug may tow over several passage vessels; when it is more boisterous, one only; and when sent alone, as might be done in extreme cases, scarcely any weather should stop her. In this way, the passage may be kept open in much worse circumstances than are sufficient to shut it, when plied in any of the usual ways.

4. The speed of a steam-boat does not altogether depend on the absolute power of her engine, nor on the qualities of her figure; but in a very considerable degree also, on the proportion which the *breadth* of her paddles bears to her power, and that which *both* bear to the resistance made to her impulsion by various circumstances of weather, and of size and build in her

own construction. The water opposed to her paddles is the *fulcrum* against which her power acts, to carry her forward; it has been found, by experiment, that these paddles ought not to dip above 18 or 20 inches in the water; consequently, the efficiency of the *fulcrum* is in the direct ratio of their *breadth*; and, all that it comes short of balancing the opposition made to the boats passing through the water, is just lost power,—power employed in displacing the water, not in moving the boat. This loss, too, is more considerable than may be perhaps imagined. In rowing-boats, even in ordinary circumstances, it is considered equal to one-third of the whole effort; and is not probably less in any steam-boat. While in some it must be a great deal more,—as witness the quantity of water which they throw up behind them; and the absolute stand still to which they are brought even in very ordinary circumstances of wind and sea,—their power at the same time still adequate to its work, still turning the paddles at the usual rate.

It must next be observed, however, that steam-boats, which are intended to embark carriages and passengers alongside a pier, are necessarily much limited as to the breadth of their paddles; they are thus limited for the sake of convenience; and also, for a still more cogent reason. They carry their cargo on deck,—their centre of gravity, when laden, is consequently high, they roll deep, and their paddles must be light in proportion. Twin-boats also, like those on the Dundee Ferry, ply their paddles at best to great disadvantage, in the dead water between the two boats; for the sake of strength in their own construction, they must have them comparatively narrow; and their bulk is enormous, and must encounter much opposition in passing through the water, particularly with a head wind. An extreme case may, therefore, easily be conceived, with respect to each of these descriptions of boats, in which a deficiency of moving power may be the defect, and yet an increase of it in the engine be no improvement; and steam-tugs alone seem to have no similar disadvantages to encounter. They may work their paddles in the best way; they may have them of any breadth for convenience; and, although there is no doubt a limit, beyond which a variety of circumstances of weather and sea will not allow them, by any means, to be carried, still tugs, the centre of gravity of which may be kept low and immoveable, may, under all circumstances, ply them wider, and with the axle lower, than any other description of steam-boat: this last circumstance being also of importance, as shortening the lever by which the water is displaced.

5. It has just been observed, that steam-paddles ought not to dip in the water above eighteen or twenty inches:—beyond this point they are found rather to force it down and lave it up, than press against it horizontally; besides which, a disadvantageous difference is made to exist between the velocity of the upper and under edges of each paddle. Steam-boats, however, plied on the usual principle on a ferry, must every trip plunge them to a different depth according to their lading, and in particular, when they have a heavy cargo on board must sink them greatly too deep for their most beneficial employment. They must thus lose power precisely as they gain incumbrance, lighting the candle, as it were, at both ends; and the disadvantage of this is now so distinctly recognized in steam-navigation, that the most improved boats, some of the Irish packets for example, have a contrivance for raising and lowering their paddles, according to circumstances. The objection to this on a ferry, arises chiefly from the trouble of the adjustment, and the little chance there is, that in short trips and ordinary circumstances it would be sufficiently attended to, although not merely the speed of the boat, but also her wear and tear, will depend upon it. Steam-tugs, however, which would never embark above a few foot-passengers, and that only occasionally, would be exempt from the inconvenience altogether.

6. It has been ascertained by actual experiment in America, "that, to enable a vessel to stem a current with an absolute velocity, equal to half the velocity of the current, it requires *three times* the motive power, if that power acts on board the vessel, that would be necessary, if the power were applied to a rope hauling her." The details of the experiment are not given in the work from which I quote (Papers on Naval Architecture, edited by Messrs Morgan and Creuze, Naval Architects, Portsmouth Yard, vol. i. p. 309., Article, Analysis of Report made to the French Government on the Steam Navigation of America); and it evidently related to the different powers required to

force a vessel up a rapid stream by steam-paddles, and by tracking. But the cases are, to a certain extent, the same. A steam-tug, by herself, will acquire a *momentum* proportionate to her qualities, and this *momentum*, applied to a rope towing another vessel, will have the same superior efficacy with that above stated, to what her power would have, were it embarked on board of that vessel,—at least, not much less in any case,—in this possibly a great deal more;—and for the following reasons. 1. A steam-tug, not being thrown out to receive a cargo, having her paddles, as we have just seen, of the best form, and working them in the best way, may be expected to be a cleverer vessel than one in which these points are subordinate to other and contradictory qualities;—she will thus be well fitted to form the entrance, as it were, of the whole load to be moved, the sharp end of the wedge to be employed in cleaving the waters. As she must have substance also as well as power (bone as well as blood) to fit her for a draught, the weight of her engine, which, in ordinary cases, is only necessary incumbrance, will be positively beneficial to her;—she will even probably require more weight, which may be judiciously disposed as ballast; and a counterpoise being thus provided against the top-weight of her engine, its several parts may be made stronger, and in some respects even disposed more beneficially than in ordinary boats. Lastly, she will deliver her power in the same straight line with the direction in which the passage-vessel is to be impelled, whereas the power in tracking acts obliquely. 2. The passage-vessel will be absolutely smaller than a steam-boat of the same capacity, because the room occupied by the machinery will be saved; she will draw less water, as will presently be shewn, than would be possible were she constructed to carry an engine; she will be built expressly to tow easily; will ply in the smooth water of her tug, which will cut the waves before her, and in some degree prevent that accumulation of water under her bows, which, increasing in ordinary cases as the square of the velocity, is the greatest obstacle to easy and rapid sailing; and the power applied to her will, if properly led, tend to lift her; and, at all events, will act in one forward direction,—whereas a rotatory impulse on board of her would act in a circle, only one or two points of which would be directly beneficial. It is this last consideration, I apprehend, which chiefly accounts for the *general* superiority of an external drag over an internal rotatory impulse; and the dispersion of power thus contemplated must evidently be proportionate to the weight of the vessel in which a steam-engine is embarked, and to the consequent *momentum* with which she scends aft in a head-sea. It must be greater consequently in a large boat than in a tug. But the others are interesting also, as particularly applying to the case under review; and it is satisfactory to find the conclusion to which they lead, supported by analogous results in cases too different, it is true, to be considered positively corroborative, but from which a general principle may notwithstanding be inferred. A horse will draw considerably more than three times as much as he will carry; and locomotive engines of six or eight horse power, and weighing, carriage and all, not above fifteen tons, will draw ninety tons, at the rate of nine miles an hour *after them*, when it is very certain that thirty tons piled *above* them, with the friction of one-fourth of the superincumbent weight (which is that of iron upon iron) would go far to anchor them at once. These engines, indeed, are usually calculated to have seven-eighths of their power disposable for the purposes of draught; and with this, as above, to draw six times their own weight on a dead level, with considerable speed. While steam-boats, as usually constructed and employed, cannot embark above the odd eighth part of their own weight and bulk; and, in circumstances of very ordinary difficulty, are almost universally complained of as deficient of power, even for their own impulsion.

Waiving, however, these presumptions for the present, thus far may be considered certain. A smaller power will move a greater weight on the tug than on the carrying system; the difference is, by a fair induction from actual experiment, not less than as three to one; and there is much in the entire circumstances of the case to make it probable that it is even a great deal more.

7. Wherever there is shoal water to contend with, the tug system seems peculiarly applicable. A large steam-boat, with a powerful engine, necessarily swims deep; and, accordingly, the

Dundee boats draw above five feet, and those at Burntisland and Queensferry towards six feet respectively, when laden. A very powerful engine, however, when embarked by itself, may, I am confident, be made to swim in four feet or less; and a passage-vessel, which is only to be towed, is in fact the lighter, the drier, and the safer, the lower and flatter she is kept. A log of wood will drag heavy and upset in the water, but a plank will not. The Yarmouth Keels, which bring stores and provisions out to the Roads, are open boats, sunk to the gunwale when their cargo is on board; yet no accident ever occurs to them. The Campeche Droguers are in like manner square boxes, with scarce a sharp end to go foremost; yet they too, load gunwale deep, bring cargoes out through heavy rollers to ships four leagues off, and survive all the apparent dangers of their passage. And men-of-war's flats are currently loaded with troops till scarce a few inches are above the water, and without risk. The truth is, that flat-bottomed boats are so buoyant, that to superficial observers, who see them move with every surface wave, they appear dangerous craft; but in the smooth wake of a tug they would be steady; in all circumstances they are steady relatively to the water in which they float; and they are the safest of all boats:—and all for the best reasons. Their bearings are so low, and if their centre of gravity is low also, the lever which acts on them is so short, that scarcely any impulse can sink one side or raise the other. They cover so much water also relatively to the materials employed in their construction, that their specific gravity is small, and scarcely any cargo or any accident can carry them down. And they are by far the best boats to take the ground, as every seaman knows.

8. Where open piers are to be approached, on which occasionally a high wind and sea directly beat, this system seems also peculiarly to apply. In such circumstances, and within certain limits, sailing-boats may approach the piers, and land one cargo; but they cannot receive another, because they cannot easily return. Steam-boats, on the other hand, cannot approach at all, so great is the danger of the piers catching under their paddle-boxes, and causing great damage. Passage-vessels alone, which have been towed across by powerful steam-tugs, may be veered in under almost any circumstances, and again towed off with an

other cargo,—their tugs remaining outside, and taking up whatever position may suit the occasion.

9. On ferries, where either time is not attended to, or where, from the state of the weather, delay is occasionally experienced in effecting the passage, it must frequently be of importance to detain the steam-power as short a time as possible alongside the piers, after it does arrive. Large steam-boats, however, as usually employed, have first to discharge one cargo, and then to embark another, before they can possibly depart; and the delay thus occasioned must be directly proportionate to their other good qualities—their size and capacity. Where an establishment of passage-vessels, however, is kept, one might be loading, while another was crossing; and, with a little arrangement and address, the tug need hardly lose a minute in effecting the exchange.

10. Passengers would be greatly safer and more comfortable in a vessel by themselves, than they can possibly be when embarked with a steam-engine. However constructed, a steamboat can never be altogether safe or comfortable as a conveyance. A small neglect of the machinery may at any time cause a great calamity; the chances of such neglect are greatly multiplied by the presence of passengers on board, and by their occasional curiosity; in the event of collision with any external object, the weight of the engine aggravates the shock; and if a hole is made in the boat, she goes down like a stone. On the other hand, the very nature of the engine makes a steam-boat roll; if she carries a cargo on deck, this effect is increased—her funnel is all additional top-weight; and the heat, smell, smoke, dirt, and jarring, caused by the engine, are all evils in their way, and at least aggravate in no small degree the pains of sea-sickness. Not any one of these circumstances, however, would operate in passage-vessels. With the means on board of anchoring, passengers would be safe in them, whatever happened; and where every corner is given up to accommodation, a thousand conveniences might be introduced, which are at present unthought of.

11. The convenient transport and safety of a great many bulky articles which there is frequent occasion to convey across a ferry, would thus, also, be much more consulted than at pre-

sent. At Queensferry, it is a very proper regulation that hay and straw shall not be embarked at all in the steam-boat; and yet the inconvenience of hoisting carts of either into the sailing-boats is very great. At Dundee, without perhaps its appearing as a matter of specific regulation, the practice is the same; and almost the only use to which sailing-boats are still applied on that highly improved ferry, is to convey flax-yarn, and other such goods, across. Were the steam-power, however, at either place, embarked in a separate boat, and merely employed in towing, such practice might easily be discontinued; and sailing-boats, with their uncertainty and discomforts, be almost entirely disused.

12. Upon the tug-system, high-pressure engines might be again introduced into steam-navigation, and their advantages secured, without alarm to passengers. These advantages are greatly undervalued in this country;—they consist chiefly in original cheapness of construction, diminished expence of working, superior lightness (nearly as 4 to 5); but, above all, in command of high power, not for current use, but in reserve against occasions when it may be required. In low-pressure engines there is no such reserve;—beyond a certain limited point, an increased fire only fatigues the machinery, without adding one jot to the useful effect: yet in every species of navigation, it is important to have it; in ordinary cases it is furnished by the *morale* of the seamen,—and in steam-navigation, it ought, if possible, to be within the *physique* of the engine[*]. All these advantages are, however, at present sacrificed to the apprehensions of the public,—apprehensions in a considerable degree overcome in America, where the subject is more studied, and the value of modern improvements is consequently more exactly appreciated; but which it would be very unwise, and even criminal, as yet to neglect here. The first step might, how-

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[*] To meet this occasional addition to the working power of the engine, it would not probably be difficult to contrive paddles which should expand and contract at will; it is not unlikely, indeed, that they are already contrived. Lieutenant Skene, of the Navy, has lately patented a form of paddles, of which I have not seen the specification; but the praise given them by the newspapers, when they were tried lately on the Thames, seems unintelligible on any other supposition.

ever, well be taken in tug-boats; it is known to all who study the subject, that it might be taken anywhere now with safety *, and the prejudice might in time be entirely overcome.

18. And, lastly, it may be observed, that in a navigable river an establishment of steam-tugs, of which the inherent principle of management was that one should always be to spare, might be a most interesting acquisition in many ways, besides the mere maintenance of the ferry to which it was attached. On many occasions tugs might most essentially serve mercantile interests, in cases of shipwreck in particular, from their great power, and comparative lightness of draught and construction, they might be invaluable in laying out anchors, and in saving life and property; and although such views are not so properly addressed to public bodies of trustees, incorporated for one purpose, and for no other, as to private speculators, yet they may not be without their value too. A great public acquisition would thus obviously be made;—an establishment organized with this farther view, together with a ferry (particularly if bound to uphold that ferry under a pecuniary obligation), would probably consist of three or more tugs, instead of two only;—on many occasions the ferry would itself reap the benefit of this additional strength;—and if any, or all, of these considerations would fix the attention of trustees generally on the superiority, in some respects, of a private, over their own public management of such concerns, a great step, it is confidently believed, would thus alone be made towards their improvement. The very circum-

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* The improved safety high-pressure boiler is composed of a number of small separate tubes or pipes, little otherwise connected than as they all discharge their steam into one common receiver, towards the production of one common effect. From their small size, they are stronger than a larger vessel could well be made; and if even one of them does burst, it has no *momentum*, can do no mischief, and the engine is in no degree deranged, as it only loses the steam generated in the one pipe. The whole apparatus is in fact safer than an ordinary low-pressure boiler; the security of which does not consist in its strength, relatively to the pressure to which it is exposed, but in what is above adverted to as the radical defect of the engine for the purposes of navigation. It has no power in reserve, consequently holds out no temptation to the engineer to subject the boiler to a severe trial. But if that is neglected, it will burst like the worst construction of high pressure boilers, and do nearly as much harm; as was proved by the explosion of the Graham alongside the United Kingdom, two years ago.

stance that a public management can have but one object, is strongly against it: things which have but one application, are always expensive, and seldom very useful. But, besides this, private managements naturally accommodate themselves to the circumstances in which they are placed; and readily adopt improvements, because they have a direct interest in doing so, and because, at the end of every short lease, what one individual will not do, another will:—while it is of the very nature of public managements to be stiff and unbending, to disregard private interests, the aggregate of which is notwithstanding that of the public, and in the road to improvement to have a *vis inertiæ*, exactly in proportion as the rank, distance, independent station, and disinterestedness of the members composing them, seclude them from the knowledge of, and sympathy with, humble wants. On the other hand, it is true that in the essential qualities of public spirit and permanence of interest, the public management has the advantage; but this only proves that a medium between both systems would be better than either:—and this medium, it is not the least praise of that plan which has now been considered in so many other favourable points of view, that it furnishes it with singular security and ease. If trustees were to find their own passage-vessels, they might let them, with their privileges, to whatever individuals would provide the power with which to ply them: and if they secured the performance of the conditions which they chose to annex to their leases, by pecuniary penalties graduating from entire forfeiture down to a smart fine for every single infraction of them, they need no more scruple at allowing their lessee to make other use of his tugs at the same time, than a coach proprietor thinks of preventing the innkeeper who horses his coach, from keeping what further establishment he pleases, and using it as he likes. On the contrary, if the system were well understood, it would become the greatest recommendation of a lessee, that he had capital and enterprize sufficient thus to fit several strings to his bow; and it may be confidently added, that it is thus (reducing the expence of employing steam, deriving a greater effect from a smaller power of it, and permitting establishments of it to serve a variety of purposes),—and thus only, that high rents can ever be got from ferries,—rents, in some degree, corresponding to the burden which they impose on the community, and to the sacrifices which have been already made in some places, and, in others are yet to make, to place them on an efficient footing. Neither need any body of trustees, beginning such a system, apprehend that they would thus deliver themselves, or their ferry, into the hands of an individual. If even a half of what has been attributed to this tug plan really belong to it, (and it is not believed to be over-stated in a single particular), it requires only to be seen, to be extensively acted on. When the present race of steam-boats shall be worn out, they will be universally replaced upon this principle; steam-tugs, for every purpose at least of domestic navigation, and for much also which may be called foreign, will be on the water what horses are ashore; and there will be the same competition for their supply.

In opposition to so many advantages, I can conceive no objection to the system whatever, except some supposed difficulty in managing two boats together in certain circumstances of tide, current, weather, &c. To this I would answer, 1st, The thing has been already done, on the American rivers, at least as rapid and stormy as any of ours. 2dly, Where there are thus great advantages to be attained, and only one small physical difficulty to be overcome, with common talent and energy, if there is a will there will be found many ways. One at present occurs to myself as very feasible. Let the two boats be connected by an inflexible rod, say of iron, broad, flat, and of sufficient strength, pivoted on the taff-rail of the tug, and extending outside 6 or 8 feet to the passage vessel, and 10 or 12 feet inside, till it can be easily commanded by a wheel like a ship's tiller. Immediately outside the tug let it be jointed so as to play up and down, but have no lateral motion except what may be given it by the wheel; and next the passage vessel, let it be fitted with jaws to embrace her stem and be loosely confined to it by a chain. With the fresh way which a powerful tug would give a passage vessel, and which would insure her towing in a right line with this rod, the whole apparatus would, I apprehend, just convert her into a very delicate and powerful rudder in nearly all circumstances; while it would also communicate to her any slow or backward movement of the engine with certainty and ease.* At all events, it might be tried or something better proposed.

And I may add, that the subject would be a very interesting one to experiment on; and it might well become some public trust to give the system a trial, even though not altogether convinced of its paramount advantages. The expence would be trifling, and the risk none; for the steam-power employed in the experiment might be hired; and a good passage-vessel, were it even only to be used in fine weather, would be a desirable acquisition on any ferry. On the other hand, if the views here contemplated are in any degree correct, they will apply to many other branches of steam-navigation, besides the mere maintenance of ferries;—the several establishments of these are at the same time rapidly wearing out, and it would be desirable to ascertain meanwhile how best to replace them, without, if possible, again incurring the enormous expence which already in many places presses heavy on local and individual resources. And there is a third application of the subject, which, to some minds, may be more interesting still. It is not probable that a steam-engine can ever be embarked to advantage in a man-of-war; the room it would occupy, and the casualties to which it would be there exposed, seem to forbid this. But in every future war, steam-towing *must* enter largely into naval tactics; and a new interest is thus thrown over the arts of peace, when improvements in them may be made to conduce to the maturing of principles and practice on which the defence of all they give us may yet in some degree depend. "Lorsqu'un nouveau genre de forces mecaniques s'introduit d'une manière utile dans

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* The American method is still simpler. Two iron rods are secured, one to each bow of the passage-vessel, so as easily to play up and down; and their other extremities are brought together, as in a triangle, and are jointed and pivoted on the taffrail of the tug. This does not impede, but does not assist her steering; and in so far only may be considered inferior to the above method,—but it is said to answer very well notwithstanding.

As general principles, the nearer the two boats are kept together, the smoother, the lighter, and the more manageable will be the draught. And inflexible rods, besides their convenience for backing and keeping the boats apart, will transmit the impulse undiminished; whereas ropes act like springs, and a considerable portion of the power is expended in merely stretching them. Hawsers, however, may be well employed as preventers, to take away even the possibility of accidental separation.

quelque branche de l'industrie humaine, il donne au peuple qui s'en empare le premier, ou qui l'exploite sur la plus grande echelle, un puissant moyen de supériorité sur les autres peuples. Souvent, enfin, le renversement des rapports de prosperité, de richesse, et de puissance entre les nations, est la suite necessaire de l'adoption et du progrès des *applications* d'une espèce nouvelle de forces mecaniques."—*Dupin.*

A few Remarks on the class Mollusca, in Dr Fleming's *Work on British Animals; with Descriptions of some new Species.* By George Johnston, M. D. Fellow of the Royal College of Surgeons of Edinburgh.—(Communicated by the Author.)

Our progress in the study of invertebrate animals, has heretofore been much retarded by the labour of consulting many unconnected volumes, through which our knowledge lay scattered; and still more by the imperfections of the system which their authors had adopted. Beings of the most dissimilar structure, and of the most opposite habits, were associated under one common name; and the learner went on, puzzled and perplexed, until repeated failures had taught him, that, in consulting their books, he was to be guided neither by adherence to the characters they choose to assign to their divisions and genera, nor by attention to nature, but by random, or a certain tact only acquired after much fruitless labour. The pertinacity with which the system of Linnæus has in this country been adhered to, is indeed remarkable. His System of Botany was confessedly left in a more finished and perfect state than his System of Zoology; and yet botanists have not ceased, from the day of his death to the present time, to alter and amend that system. On the contrary, our leading zoologists bound themselves in willing fetters, deprecated any alteration, however obvious, and pleased themselves with laudatory pæans. Happily those days are past; and, though foreigners have led the way to better systems, and consequently to a more accurate and extended knowledge of animated beings, yet the example of our present naturalists justifies the belief that we shall not long be second in this race of science.

The system which Dr Fleming has adopted is a modification of Cuvier's, and is founded on the basis of structure and function. It is commensurate with the present state of the science; and, in following it, the student will not meet with, as in preceding works, any very unnatural or ridiculous associations; though, at the same time, we wish not to conceal our opinion, that the arrangement here developed will not, we fear, be generally assented to. Nor is this a matter to be lamented; for there can no harm arise from a multitude of systems, provided we can only agree in a uniformity of nomenclature, so far as regards the genera and species. A change in *these* is a positive evil, and never to be made without sufficient reason; but a new system, by presenting the objects under various aspects, and placing, in a more or less prominent view, the organs of different functions, is in fact beneficial to the progress of knowledge.

But we have no intention to enter into a review of Dr Fleming's work; we wish merely to submit a few remarks, as they presented themselves, on examining that portion of it which is devoted to the elucidation of Molluscous Animals.

And first it seems to us, that Dr Fleming would have done well to have quoted more frequently than he has done, the "Histoire Naturelle" of Lamarck. That work is in general use amongst the naturalists of this country; and it is necessary that the student should be acquainted with its language or synonymes, whether he may choose to adopt them or not. This consideration should have prevailed with Dr Fleming, in opposition to any private opinion he may have formed of the merits of that production: and it is surely worth quoting; for the systematic part is both ably and ingeniously executed, though we are free to admit, that the changes in the nomenclature are not to be vindicated, and the physiological speculations are puerile and absurd, and have none of that originality apparently claimed.

Spirula australis was first added to our Fauna by Mr Stewart, the author of Elements of Natural History. His specimen was procured from Aberlady Bay.

Loligo sepiola we have from the coast of North Durham; and from the same coast we procured the *Octopus octopodia*, a fine specimen of which was sent some months since to the conductors of the Zoological Journal, under the impression of its not having been previously observed. The *Lol. sepiola* was brought to us alive, though in a languid state, and it continued so for about twelve hours, yet it never discharged any inky fluid, nor was the spirit in which it was preserved tinged in the slightest degree.

In *Arion* and *Limax*, the mouth is a short retractile proboscis, armed on the upper lip with a semilunar horny plate, the concavity turned downwards, and a blunt tooth projecting from its centre. In the first genus, the margin of the shield is entire; in the latter, it is cleft below the pulmonary aperture. In giving "black tentacula" to *Limax agrestis*, as a specific character, Dr Fleming has incautiously copied his predecessors; for, in truth, they are not black, but like to the body in colour, as an examination of the first individual that crawls across his path will convince him. We add a description of what we consider a new species of *Arion*.

1. A. CIRCUMSCRIPTUS.

Body greyish-black, spotted, with a black fascia round the shield and body; the respiratory aperture anterior.

Limax agrestis? Latham, Lin. Trans. iv. 85. t. 8. f. 1, 4.—*L. marginatus*? Muller, Verm. ii. 10.

Hab.—Moist meadows, hedge-banks, &c.—Common.

Desc.—Body 1 or 1½ inch long, not keeled, nor much narrowed at the tail; greyish black, marbled, with a narrow fascia surrounding the back and shield; sides bluish-grey; foot white, opaque; tentacula rather short, black; respiratory aperture placed very forward on the shield, which is entire; mucous pore very distinct, above the tail; the young are white or straw-coloured, with blackish head and tentacula.—This species has probably been passed over as a variety of *Limax agrestis*. We have found it very uniform and constant in its character, though it may possibly be the *Ar. ater* in an immature state.

In the genus *Helix*, we find two species which Lamarck has, perhaps with greater propriety, placed in the genus *Carocolla*. These are the *H. albella* and *elegans* of Draparnaud. The *H. nitida* and *nitidula* of the last author, and the *H. alliaria* of Mr Miller are brought together as synonymous; and, in confirmation of this arrangement, we may mention an experiment which we lately made. Four specimens of equal size, and alike in colour, and in the number of their whorls, were taken from beneath one stone. None of them had any smell while alive; but, on immersing them, one by one, in hot water, two emitted a very strong alliaceous smell, in one it was faint, and in the other it was not perceptible. It would appear, therefore, that the animal has the power of retaining or emitting its peculiar odour at pleasure; and that, in death, its emission may be prevented by accidental circumstances. I could not satisfactorily ascertain its source; but it appeared to arise from a yellowish fluid pressed out from above the head. I cannot so unhesitatingly assent with Dr Fleming, in considering the *H. caperata* of Montagu as synonymous with the *H. striata* of Draparnaud. The latter is the most common of all shells in the vicinity of Berwick, and the white rib within the outer lip is a constant character. Now, Montagu takes no notice of this in his description; and we all know how minute his descriptions are; while Dr Turton expressly states, that the *H. caperata* is to be distinguished from *H. virgata*, " in wanting the thread-like rib round the inside of the lip." Moreover, the figure of Montagu is not at all like to the *H. striata*.

Though the construction of the genera of the remaining land and aquatic *Pulmonifera* might afford occasion for remark, we shall now pass on to the naked *Branchifera*. In *Tritonia*, we observe, that the *T. coronata* which is a native of the Frith of Forth, was not known to the Doctor; and the two species which follow do not appear to have been yet described.

1. TRITONIA PLEBEIA.

Body oval, narrowed behind, greyish; superior tentacula multipartite, cylindrical; branchiæ uniserial, dendroidal.

Hab.—The sea near Berwick.

Desc.—Body one inch long, 4 lines broad, truncate before, tapered to a narrow point behind, limaciform, greyish, irregularly speckled and blotched with brown. Back slightly convex; sides abruptly flattened with the markings of a deeper colour; foot white. The anterior margin of the cloak, above the mouth, is cut into 6 or 7 short conical filaments, partly retractile. A little behind are the two short cylindrical sheaths from which the tentacula issue. These consist of a fascicle of filaments united at the base; and arranged apparently round a central pillar of whiter colour; and are only displayed when the animal is active and in motion. Along the margins of the back there are 5 or 6 branchial processes, gradually decreasing towards the tail, and having an apt similitude to an old and leafless tree in miniature.

2. TRITONIA PULCHRA.

Body oblong, red with 3 whitish transverse bands, and marked with minute ocellated spots.

Hab.—The sea near Berwick.

Desc.—Body rather more than ¼ inch long, oblong, of equal breadth throughout, of a fine red colour with dark spots, and 3 narrow white transverse bands. The back when minutely examined is observed to be marked all over with ocellated spots, of which the ring is white and the eye red. Anterior margin of the cloak white, rounded and emarginated in front, and the sides tuberculated. Superior tentacula exactly like those of the preceding species. On the margins of the back are several branchial processes or tubercles, some of which are branched. I have had 3 specimens of the *Trit. pinnatifida* from the same coast.

I cannot agree with Dr Fleming in considering the *Doris papillosa* of Montagu, and the *D. vermigera* of Dr Turton as the same species. In the former the superior tentacula are said to be annulated, a structure which we did not observe in specimens of the latter which we found on the neighbouring coast; in the *D. papillosa*, the lateral papillæ or branchial filaments are stated to be subclavate, in the *vermigera* they are linear, or conical; and the latter wants the bare triangular space on the anterior part of the back, as represented in Montagu's figure, and taken notice of in the description. The *Eolis peregrina* is said by Dr Grant to inhabit the Frith of Forth, though not described either by him or Dr Fleming.

The *Valvata cristata* is mentioned as a native of England only. It occurs in abundance in the Whitadder, a river which runs through Berwickshire, and is therefore to be added to the Scottish Fauna. Though we have kept it by us days and weeks, we have not yet had the pleasure of seeing it protrude its beautiful plumose branchiæ.

We feel indebted to Dr Fleming for his elucidation of the genus *Chiton*, which was getting into confusion, and chiefly from a neglect of what he had done many years ago, in the article "Conchology" in the Edinburgh Encyclopædia. That excellent article has been strangely overlooked by subsequent conchologists. It is true Dr Turton, in his Conchological Dictionary, has once or twice referred to it, but so inaccurately as to statisfy us that he had not consulted it, a circumstance rather surprising in an author who has dwelt with unusual severity on similar inaccuracies in others. Dr Fleming has omitted the *Ch. punctatus* of Turton, in the probable belief that it is merely an imperfect specimen of some other species. On the coast of North Durham we have collected the *Ch. marginatus*, *ruber*, *cinereus*, and *lævigatus*,—the first very common, and of a large size, the three latter all very rare.

The genus Bulla is left much as our author found it, and there is perhaps no one in the sytem of which so little is known. We add the description of a species which appears to be new.

1. BULLA PUNCTURA.

Shell oblong-oval, opake, white, marked with numerous close transverse punctured striæ.

Hab.—Sea coast near Berwick.

Desc.—Shell 4 lines long, thickish; apex with a very narrow perforation. It resembles the *B. ampulla* of Montagu in shape, but is distinguished by having the whole surface punctured, and these punctures are arranged in regular striæ. Only one specimen has occurred, and a part of the outer lip appears to have been broken off during the animal's life, and again renewed. This portion is smooth.

In the *Holostomata* we could have wished that Dr Fleming had adopted the genus *Lacuna* of Dr Turton, instituted for the reception of some closely allied species which we find placed in the genera *Turbo* and *Natica*. The *Nerita pallidula* of British authors, and its allies, are certainly not *Naticæ*, for the perforation is on the pillar and not behind it, and the eyes of the animal are inserted on a bulging part of the base of the tentacula, and not elevated on peduncles. The *Turbo margarita* also affords a good instance of the empiricism which we think we observe to prevail in the establishment of genera; and of which other illustrations might readily be adduced *. Captain Laskey, its discoverer, and Mr Montagu, made it a *Helix*; Dr Leach considered it *sui generis*, and called it *Margarita*; Dr Turton and

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* We cannot, for example, conjecture on what principles the establishment of such genera as *Montagua*, *Aplexa*, *Myxas*, *Balea*, &c. can be justified. The class *Conchifera* will afford, we think, similar examples; and we may remark that in that class too much importance has been attached to the cardinal teeth as furnishing generic characters.

Mr Lowe removed it to *Turbo*, and for doing so the latter was rebuked by Mr Gray, who maintained, that, with Linnæus, it could be nothing but a *Trochus*, and in this opinion Mr Lowe afterwards coincided, though on grounds which are unintelligible to us. In face of the censures of Mr Gray, however, here we have it again a legal *Turbo*,—and if the student asks a reason for these changes, there is none to give, unless the whim of each naturalist is to be considered as reasonable. If we consider the genus *Margarita* as unnecessary, and in our humble judgment it is so, then we submit the species in question is a *Trochus*, and we rest our opinion, not so much on the general contour of the shell, as on the structure of the animal. No true *Turbo*, so far as we are aware, has the sides furnished with tentacular filaments; but these organs are general in the *Trochi*. Now, the animal of *T. margarita* has four of these filaments on each side, and the margin of the cloak between the tentacula is beautifully crenulate; and further, the eyes are on pedicels, a character in which it likewise agrees with *Trochus*, and differs from *Turbo*. The species which Dr Fleming has admitted into the genus *Phasianella* have a very doubtful claim to their place; and none at all, if we agree with Mr Sowerby in restricting it to such as have a calcareous operculum. The *Cingulla pulla*, in his view, is a true *Phasianella;* and there is, moreover, sufficient in the structure of the animal to induce us to remove it from the *Cingullæ*, for these, if we are entitled to form a conclusion from the recent species common on our shores, have no additional tentacula, and a very thin horny operculum. The *Phasianellæ* of Dr Fleming might perhaps constitute a new genus

The following species appears to be nondescript.

1. CINGULLA PULCHRA.

Shell conical, white, with two rows of brown spots on the whorls, which are spirally striate.

Hab.—Sea shore near Berwick.

Desc.—Shell 1½ line long, conical, glossy, spirally striate, white, with two rows of oblong reddish spots on the body and second whorls: striæ regular, impressed. Whorls 6, rounded and well defined. Aperture roundish, narrowed above, with even margins, and a slight perforation behind the pillar.

Obs.—A much prettier shell than the *C. interrupta*, from all the varieties of which it is readily distinguished by its spiral striæ. From the *C. cingilla* it differs in form and in markings.

Of the pretty and rare shell named *Velutina stylifera* we have a specimen in our small collection from the coast of North Durham, and taken, as Dr Turton's specimens also were, from amongst the spines of the *Echinus esculentus*. We can confirm the assertion of Dr Turton of its having no operculum, but unfortunately at the period it occurred to us, we were more intent on collecting species than observing their habits and structure, and can at present add nothing more to its imperfect history.

It was my intention to have reviewed in a similar manner the remaining orders and families, but as our remarks consist, we find, in mere differences of opinion, we shall not extend a paper which has already exceeded the limits at first proposed. So far as we are aware the enumeration of the species seems most complete, nor do we observe an omission except that of *Planaxis mollis* and a nondescript *Ianthina*, which, it is said, have been added to our Fauna by Dr Leach. We may be allowed also to express a regret that Dr Fleming should have followed Turton in affixing the name of the learned Dr Goodall to a genus of bivalve shells, which future observations may prove have no claim to a place in the system. Mr Sowerby has already pronounced one of the species to be the young of an *Astarte*, and it seems insinuated that the other species has no better claims to be considered distinct.

April 1. 1828.

Defence of Christianity, or Conferences on Religion; (Defense du Christianisme, ou Conferences sur la Religion.) By M. de Frayssinous, Bishop of Hermopolis, First Almoner to the King of France, Minister for Ecclesiastic Affairs and Public Instruction. 3 vols. 8vo. Paris.

Moses considered as a Historian of the Early Ages, t. ii. p. 49.

M. Frayssinous, in his Conferences, considering Moses as a historian of the early ages, examines his narrative, with reference to the two principal facts recorded in Genesis, namely, the

Creation and the *Deluge.* It will be useful to shew, then, how the explanations of the learned prelate have rendered all rational disputation between science and orthodoxy henceforth impossible; it will also serve to convince religious men that they need not now, from scruples of conscience, refuse to give their assent to the sound theories of science; and, lastly, it is of importance in giving a more extensive diffusion to accurate ideas respecting the book of Genesis, and the principal geological facts related in it, that the useless discussions which frequently arise in the world may be avoided;—such, for example, as disputes with regard to the age of the world—the universal deluge—whether the fossil shells were produced by the Mosaic deluge, &c.

By distinguishing, in the language of Moses, the expressions in common use, which it was necessary for him to employ, in order to be understood, and by making allowance for the difference of times and of nations, and for the genius of the Hebrew language, and by adhering, at the same time, to the narrative of the historian, M. de Frayssinous has consecrated, by his suffrage, interpretations which have been elicited by a conscientious judgment. Henceforth the cosmogony of Moses, assuming in some degree a different character, presents only an assemblage of facts, which enter, without effort, under the dominion of the natural laws, imposed from the beginning by the Creator of the universe, and which, therefore, harmonize with the enlightened opinions that may be formed regarding the origin of the globe. For this important observation must not be overlooked: Moses lays down his cosmogony in few words, and in very general terms; and the meaning of the word *day* being once fixed, we have only to consider the order and succession of creations there recorded. M. de Frayssinous shews the agreement thus subsisting between scientific facts and the Mosaic record, viewed in its true light, and in this respect he renders an eminent service to religion, to science, and geology.

When, in fact, we call to mind the lamentable disputes which have taken place, in these latter ages, on the subject of the Book of Genesis; when, on the one hand, geology, formerly so theoretical, appeared to encourage the attacks of infidel philosophers, and, on the other, religious men, possessed sometimes of more zeal than science, denounced, with so much heat, opinions which, at the present day, give no offence to the lights of the church,—we are constrained to hold forth to public approbation the spirit with which the Bishop of Hermopolis has considered this book, and to extend the knowledge of the opinions which he adopts on the fundamental points which it contains,—as thereby furnishing the friends of religion, science, and geology, who might still find themselves exposed to attacks similar to those to which we have been alluding, with victorious arms for repelling them. . . . .

If, however, there is at the present day one truth more than another to which general assent is given, it is this—that the progress of all kinds of real knowledge has entirely banished from us that spurious philosophical spirit, of which so much is still said, as if it could be renewed. What geologist is there, in our days, who, while he admires the exalted genius of Voltaire, is not moved with pity at his scientific arguments against the book of Genesis? And do we now see a single dissertation of a similar nature, by any writer, enjoying the smallest degree of reputation in the scientific world? Were a work of this description to appear at the present day, would not the silence and dissatisfaction of the learned consign it to neglect, more promptly, and with more effect, than the *Index* of the Sorbonne could ever have done? In vain do some interested, or too credulous, individuals attempt to revive the terror of such philosophers; there is nothing to justify their alarms: and did not every thing around us testify, that science is always the surest guide for man, geology (which, after having in its infancy furnished weapons against the sacred writings, may now be rendered subservient to the support of the Mosaic cosmogony) would furnish a memorable example. In truth, setting aside the considerations and sentiments which command belief, it is upon M. Cuvier's researches that the most important fact in the Mosaic record, namely, the order of the creation of living beings, rests; it is the investigations of MM. Champollion and Letronne, which M. de Frayssinous adduces in support of his historical relations; and, lastly, it is the discoveries of Dr Young and M. Fresnel that afford the learned prelate the means of explaining the passage of Genesis, which refers to the creation of light. We are therefore authorized to repel with indignation the perfidious and calumnious insinuations which a disordered mind would endeavour to propagate against men of science in general, and geologists in particular. All that the learned now request, is, that they may be allowed to enjoy in peace the fruit of their labours, and that the cause of religion may not be inconsiderately blended with the results of their inquiries.

We must observe, that, with respect to ourselves, we only consider the Book of Genesis here as an historical monument of the highest antiquity; in other words, simply in a scientific point of view: any other mode would be out of place in the bulletin *. Buffon, De Luc, Buckland, Webster, &c. have given great interest to this examination; and it is time that the conventional ridicule which some learned men attach to the study of this valuable monument should be done away with, when so much labour is every day applied to the scrutiny of the cosmogonies of the Chinese, Hindoos, and Egyptians; when history does not even disdain to interrogate the dumb monuments of the remotest dates, or the most extravagant allegories of the nations of antiquity. Without seeking to support an opinion or particular mode of thinking, one may take cognizance of a fact, and intolerance would be as blameable on the one side as on the other.

The Bishop of Hermopolis, resting on St Augustine's opinion with regard to the meaning of the word *day*, expresses himself in the following manner, on this fundamental question. " The chronology of Moses dates less from the moment of the creation of matter than from that of the creation of man, which only took place on the sixth day. The sacred writer computes the number of years of the first man and his descendants, and the chronology of the Holy Books, therefore, is made up by the computation of the years of the successive patriarchs; so that it extends less to the origin of the globe itself, than to the origin of the human species. Henceforward we can say to geologists, dig as much as you please into the bowels of the earth, if your observations do not require that the days of creation should have been longer than our ordinary days, we shall continue to follow the common opinion respecting the extent of these days; but if, on the contrary, you discover that the terrestrial globe, with its plants and animals, must be much older than the human race, the Book of Genesis will have nothing to say against such a discovery; for in each of the six days you are permitted to see so many indeterminate periods of time, and then your discoveries will be the explanatory commencement of a passage, the meaning of which is not perfectly determined."

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* Bulletin des Sciences Naturelles.

Now, observation shews, that a long period of time elapsed, 1*st*, between the consolidation of the primitive strata of the globe and the appearance of life at its surface; 2*d*, between the creation of the different species of plants, and the various races of animals; 3*dly*, between the latter and the creation of man. The proofs of these facts are undeniable, as these strata are the product of a succession of slow effects, and the remains of plants and animals which some of them contain, suppose a prodigious succession of distinct generations. The idea, therefore, of days like ours is repelled by facts; and we do not even yet possess any means of estimating the duration of the epochs in question. It is a calculation of the same nature, as that of the distance of the fixed stars from the earth, and nothing is more ridiculous in the eyes of one who is occupied in such investigations, than to hear people speaking *of the age of the world, the antiquity of the world, &c.*

As it is equally certain that the human species is the last in the order of creation, since its remains do not occur among those of the other living beings which abound in the solid strata, even the most superficial, of the globe, it may be said that all the phenomena, whatever they may be, to which the formations of these strata may be referred, belong to the scientific history of the epochs, antecedent to the existence of man. From this may be seen the emptiness of the expression which we every day hear repeated, that the *revolutions to which the globe bears testimony are a proof of the universal deluge.* It is evident, from what has been already said, that it is at the surface of the earth only, that we can look for, with some English geologists, the traces of this great cataclysm; and that the shells, the bones of animals, and the impressions of plants, which are found in the solid strata of the globe, have no connection with the deluge, since the object for which it was produced was the destruction of the human race, and as all these strata, as well as the phenomena which have changed their order or inclination, are anterior to the existence of man.

God, as M. de Frayssinous has observed, could certainly, by an act of his will, have created at once the whole consolidated earth, and all the beings which embellish it; but as nothing prevents us from thinking that the will of the Creator might have received its accomplishment by a concatenation or succession of effects, more or less rapid, or slow, with reference to the duration of human life, and as orthodoxy makes no opposition to the six days' work being considered as *six indeterminate periods of time;* and, moreover, as Moses has not entered into a detail of the first causes by which God determined this succession of effects, and as the only circumstances which he relates agree with observation, or with the inference which the laws of nature authorise, we can without difficulty admit this succession or concatenation of effects, dependent upon first and pre-existing causes, which has successively, and in the way of consequence, brought about the formation of the earth, and the modifications which its surface has undergone.

Following, according to the Bishop of Hermopolis, the series of the six days' work, we shall briefly make known the rest of this conference.

On the first day, *God created the heavens and the earth. At first the earth was covered with water, presenting the appearance of a dark abyss; but God said, let there be light, and there was light.* With regard to the creation of light before the sun shone in the firmament, M. de Frayssinous demonstrates that the objections which have been made on this subject are of no validity; admitting, always with the learned prelate, that Moses meant less to say visible and produced light, than the creation of the substance which may develope light. He founds his opinion on the researches of Dr Young, and those of M. Fresnel, which have made the theory of vibrations prevail over that of emission, which Newton supported. According to the first of these theories, the creation of the fluid which was to become luminous, was independent of the creation of the sun, that star being even considered, since the time of Herschel, as an opaque body, and therefore light may have been in fact produced from the beginning.

By the creation of the heaven we can only, however, understand space, and the bodies which compose the universe, all which might then have been, as is now, comprehended in that indeterminate acceptation. But this creation does not absolutely suppose the existence of stars in the state in which we now see them. The sun might form part of the creation of the heaven, without having yet that luminous lustre by which it is now distinguished; nor do scientific theories oppose the admission of such a hypothesis. Thus there is nothing to prevent us from supposing that the manifestation of the stars took place only on the fourth day, or at the fourth epoch. The author has not even thought it necessary to mention this observation.

He gives an account of the opinions of geologists or natural philosophers, respecting the original fluidity of the globe, to shew that, in fact, the earth was covered with water. This opinion is at the present day one of the most incontestible facts. At the same time, observations leave no doubt with regard to the igneous nature of the fluidity of the globe at the beginning; but scarcely had the cooling of its surface permitted the gases of the immense atmosphere which surrounded it to condense, when in fact the surface of the earth was entirely covered with water. Thus the account of the first day's work must be considered by every mind, not led away with prejudice, and not seeking in it for that strictness of expression with which the very general terms in which it is delivered are incompatible, as being in perfect accordance with the facts and theories admitted by science.

On the second day, *the waters which enveloped our planet, were divided in such a manner, that a portion rose into the upper regions.* On the third day, *the dry land began to appear; plants sprung from its bosom, verdure and flowers embellished it.* On the fourth, *the sun, the moon, and the stars shone in the firmament.* On the fifth, *fishes swam in the waters, birds flew in the air, reptiles crept in the dust, and quadrupeds walked on the surface of the earth.* Lastly, on the sixth, *man appeared.* The Bishop passes rapidly over all the facts contained in this part of the Mosaic record, with the exception of the work of the sixth day; he has not judged it expedient or necessary, it would appear, to explain each of these facts in detail, but confines himself to some general reflections, with the view of shewing that this successive formation of beings is not opposed by any authenticated observation. In fact, the second period designates the time when an equilibrium must have been established between the waters of the sea and those which are contained in the atmosphere; the third, that when the successive diminution of the waters uncovered the first surfaces of the earth, which henceforth were enabled to invest themselves with that primitive vegetation, the remains of which are found in the oldest secondary rocks; but here it is necessary to clear up a difficulty which has frequently been adduced as a very embarrassing argument, and to which recent observations enable us to give a satisfactory explanation. How could plants have grown and propagated at a time when the sun did not yet shine in the firmament? The proper heat acquired by the terrestrial globe from its original incandescence, was sufficient to develope and support this vegetation, and may explain the apparent difficulty in quéstion. The central heat of Buffon, which has thrown so much discredit on the theory of that illustrious naturalist, is now among the number of the most accredited facts, and is supported by all the observations in geology and physics. The phenomena of volcanoes, earthquakes, and hot springs, can only be accounted for by this hypothesis; all the circumstances of which are moreover in accordance, as M. Fourier has shewn, with the mathematical theories respecting the cooling of bodies submitted to the influence of a high temperature. We were the first who, in these latter times, endeavoured to revive the memory of Buffon with regard to the fundamental ideas of his theory of the earth, and to explain all the changes which the animal and vegetable kingdoms have undergone at the surface of the globe, principally on the ground of the reduction of temperature. Our theory on this subject was even extended by a learned Englishman, Dr Crichton, who proved the independence which the original climate of the terrestrial globe must have maintained with respect to the solar heat. All the proofs which he adduces form a blaze of light which leaves no doubt regarding this subject; so that, proceeding from this important datum, we not only can conceive how the primitive vegetation of the earth's surface could have existed independently of the solar heat, but the same observations prove that the proper temperature of the globe, and a uniform mean temperature much more elevated than that which now reigns at its surface, may of themselves have given rise to the vegetation of that period. In fact, the remains of this vegetation occurring near the Pole, and under the Line, shew that it was equally uniform,—that it was analogous to that which now covers the equatorial zones,—and that thus the differences with regard to the vegetable productions of the globe, arising at the present day from differences of latitude, did not then exist. Every thing proves that, in this original climate, the periodical seasons of our present climates, depending upon the obliquity of the ecliptic, and the preponderance acquired by the solar heat, had no existence. The proper heat of the earth's surface having a great elevation, the influence of the sun's heat, admitting its atmosphere to have been already in a state of combustion, would have been scarcely, if at all perceptible. What we have said renders all explanation unnecessary respecting the fourth day, the period when the stars became visible, and shone in the firmament. With regard to the fifth, the order of creations therein enumerated is in perfect accordance with the order in which the fossil remains of the various races of animals occur. Animal life was first developed in the bosom of the seas, then in the air, reptiles followed, quadrupeds next, and lastly man. This succession, besides being proved by direct facts, is conformable with the various phases through which the earth's surface must have passed, to be successively adapted for receiving the different races of living beings. We long ago proved, *1st*, That the analogy of station and destination, in other words, of the conditions of existence, and of the office to be be fulfilled, is the general law which has presided over the distribution of life upon the globe. *2d*, That the changes which life has undergone on its surface have been graduated, but that life itself has not been renewed; that the races have not been modified, but that, in proportion as the conditions of existence changed, or as new ones were formed, new species occupied the place of those which were no longer able to exist, and which had no longer an object to fulfil; and that they went on, up to the period when, with respect to each part of the surface in succession, an equilibrium was established between the influencing causes. The animals of these times were proportioned to the original vegetation; and this is the reason why we find everywhere remains of elephants, rhinoceroses, lions, &c. Animal and vegetable life has been modified in the same points, by the causes which we have just pointed out, the diminution of temperature at the surface of the globe, and the establishment of terrestrial climates.

M. de Frayssinous then discusses the question, Whether the stars are inhabited? "Fontenelle's *Plurality of Worlds* may perhaps, he says, be nothing but an ingenious romance, but you are free to see a reality in it." He next examines the question so much agitated at the present day, Whether the human race constitute a single species? All the moral reasons which he adduces in support of the opinion that men are derived from the same source, are of great validity; and he admits Buffon's ideas regarding the differences which the influence of climate, food, and other causes, may have operated upon the original stock, in its successive generations, and which have produced the modifications now observed in the different races. We have put it beyond doubt, that, with regard to animals and plants, it is necessary to admit particular centres or basins of production, just as we admit in physical geography, basins and hydrographic masses recurring over various parts of a great surface, or in opposite continents, and being affected among themselves by a variable number of differences and analogies. At the same time, the basins and centres of productions present similar, equivalent, or different productions, according to the places; and the animal creation, like the vegetable, has been subjected to certain conditions dependent upon the form and nature of the soil, and the state of the air and waters, so that certain genera, and even certain species, are reproduced at great distances, and even upon opposite continents, without the possibility of supposing that they have arrived there by diffusion, or by proceeding from a simple centre, or from several distinct centres of production. But these observations, which we believe it impossible to refute, may yet prove nothing with regard to the human species, and new facts are required, before science can adopt a rational opinion on the subject.

The bishop now passes on to the examination of the traditions respecting the deluge, and brings together all the historical evidences transmitted by the most remote antiquity, which tend to support the traditions of that great event. He examines it, in the last place, with reference to its chronological relations. On this subject, we have to observe, that MM. Champollion have shewn that the chronology of the Seventy, adopted by the fathers of the church, is sufficient to account for all the facts recorded in history. As to the means which God employed in producing the deluge, this, although treated by the Bishop at great length, is a subject of little importance in itself; the figurative language of the sacred historian affords no precise information on this point, except that he speaks of extraordinary rains, which he must mean by the cataracts of heaven. God could undoubtedly have disposed of the elements at his will; but without having recourse to incomprehensible means, and viewing the deluge as it ought to be viewed, that is to say, as confined to the part of the earth then inhabited, some less general phenomenon will suffice to account for it.

The only point of importance to be established is, that the deluge was not universal. Respectable authorities are not awanting in support of this opinion; we might, among others, adduce the testimony of Mabillon, who maintained this opinion at a meeting of the Congregation of the *Index* at Rome, where it was admitted by the nine cardinals who assisted. The object of the deluge was the destruction of the human race; it was therefore unnecessary to bring a general cataclysm over the parts of the earth that were not yet inhabited. Moses calls it universal merely with reference to the then known earth; but he did not certainly comprehend under it America and New Holland. This interpretation, while it is more consistent with reason, and more accordant with geological observations, which formally repel the idea of cataclysms and perturbations of all kinds, cannot be considered as contradictory to the spirit of the sacred text.

Ferrusac.

Remarks on the Nature of Sound in Water. By MM. Colladon and Sturm.

We shall now offer a few remarks on the nature of sound in water. The first relates to the *duration of sound in water*, which differs in a remarkable degree from its duration in air. The sound of a bell struck under water, and heard at some distance, has no resemblance to that of a bell struck in the air. Instead of a prolonged sound, there is only heard under water a short and sharp noise, which I can compare to nothing better than to that of two blades of knives struck against each other. On retiring indefinitely from the bell, the sound always preserves this character, only diminishing in intensity. The perception of a sound so sharp and short coming from a distance of several leagues, causes a feeling similar to that which one experiences on seeing distant objects through a telescope with the clearness which that instrument gives to them. In making the experiment at intermediate distances, the sound always appeared to me the same in nature, insomuch that I found it impossible to distinguish whether it came from a strong and distant stroke, or a weak and near one. It is only at a distance of about 200 metres, that the ringing of the bell begins to be distinguishable after each stroke. In the air we observe a phenomenon almost entirely the reverse. The strokes applied to a bell are more distinctly heard at hand, whereas at a distance there is only heard a continued and almost uniform tingling. The resistance which the water opposes to the vibrations of the bell, does not afford a sufficient explanation of this fact, for the same sound heard out of the water was much more prolonged; the sound of a bell was very well recognized, which would have been impossible, in listening at a distance to the same noise transmitted in water. This phenomenon is explained by the nature of the vibrations of sound in water. It is known, in fact, that, in the vibratory motion of a fluid, the duration of agitation of a particle is equal to the radius of the spherical portion of the fluid which is originally shaken at the commencement of the motion, divided by the velocity of transmission of the sound. The first of these two qualities is necessarily smaller in water than in air; the second, on the contrary, is greater; whence it follows that the duration of sound ought to be much less when it is transmitted through water, than when propagated in the air.

The second remark relates to the *non-transmission of the sound from water into air*, when the vibrations which are propagated in the water arrive at its surface under a very small angle. Thus, as I have said, at a distance of less than 200 metres, the sound of the bell struck under water is easily heard in the air; but, at a greater distance, its intensity diminishes very rapidly, until at length, at the distance of 400 or 500 metres, it is impossible to distinguish the slightest sound, even very near the surface of the water. However, on immersing the head a few centimetres, or by putting down a tube filled with air, as I did, the sound of each blow is heard strongly and distinctly, and in this manner it is heard at a distance from ten to twenty times greater. It is evident, that, at a distance of 500 metres, the vibrations arrived at the surface under a sensible angle, which was further increased by the curvature of the earth. The vibrations which take place in water, do not therefore communicate with the air, when their direction meets the surface at a small angle,—a phenomenon analogous to that presented by the surface of separation of two mediums of different densities.

The agitation produced by the waves does not alter the duration of sound nor its velocity, when a tube is used for hearing. The last of the three experiments mentioned above was made in stormy weather. The wind, which at first was weak, increased to such a degree, that several anchors were necessary to hold the vessel. Notwithstanding the noise of the waves, I could still distinguish pretty well the sound of each stroke, and the duration of its transmission was not altered.

The last observation which I have to make, relates to the *influence of screens on the intensity of sound.* Having chosen two stations, at no great distance from each other, and so situated that the straight line which joined them grazed the extremity of a thick wall which rose above the level of the water, I had the bell struck regularly, and with strokes of equal intensity. Hearing them with the tube alternately on either side of the line which grazed the extremity of this wall, it appeared to me that there was a very marked difference of intensity, according as this extremity was or was not interposed between the bell and the tube. The transmission of sound in water, therefore, differs in this respect from what takes place in air, and approaches to the mode of the propagation of light. This influence of a screen insensibly diminishing the intensity of sound, deserves to be remarked, and affords a new point of approximation between the phenomena of the propagation of sound in liquids, and those observed in the propagation of light.

Observations on the Fluids contained in Crystallized Minerals. By William Nicol, Esq. Lecturer on Natural Philosophy. Communicated by the Author.

To Professor Jameson.

Dear Sir,

Being under the necessity of going into the country, I cannot at present continue the investigation I was engaged in, concerning the fluids contained in the cavities of crystallized minerals. I shall therefore now give you the result of the observations I have already made.

About two years ago, when polishing a fragment of a crystal of sulphat of barytes, having a cavity containing a fluid and a small moveable globule of air, a partial rent took place from the surface into the cavity. The consequence was, that the globule of air immediately began to expand, and continued to do so until the whole of the fluid was expelled from the cavity. The fluid did not form a continuous line along the rent, but appeared in the form of three or four distinct globules, one of which was considerably larger than all the rest. After inspecting these globules for some time, and seeing no change in their appearance, the fragment was laid aside. On examining it next day, each globule was found to be a solid crystal, having the primitive form of sulphate of barytes, namely, a right prism with a rhombic base. The waste by evaporation, if any had taken place, must have been very little, for the crystals seemed to be nearly as large as the globules from which they resulted.

Some time ago, I found in my cabinet a crystal of sulphat of barytes, containing several cavities, in each of which there was a fluid, and a moveable globule of air. With several of these I have succeeded in getting the fluids to the surface through partial rents, in consequence of the expansive force of the air. The fluid always oozed out in the form of distinct globules, of different magnitudes, one of which was generally larger than all the rest. The globules, however, from different cavities, assumed different appearances. Those from one cavity, for instance, were nearly hemispherical, and seemed of considerable density, those from other cavities spread out to a considerable extent, indicating less tenacity, and a greater attraction, between the particles of the fluid and the surface on which they spread. The globules, too, form different cavities, crystallized with very different degrees of rapidity. Several minutes elapsed before the dense hemispherical globules of one cavity began to crystallize. The crystallization then went on slowly, and was not completed until after the lapse of twenty-four hours; whereas most of the thin flattened globules from other cavities, crystallized almost the instant after they reached the surface. The dense hemispherical globules seemed to lose very little by evaporation; but the thin flattened globules seemed to sustain a very considerable loss by that process.

In the instance first mentioned, each globule of the fluid formed only one crystal; but in all the others, each globule gave forth a considerable number of crystals. These were always arranged in a curve, immediately within the circumference of the globule. Sometimes the crystals were aggregated together, sometimes they were more or less detached, and sometimes a detached crystal or two formed within the curve. The whole of the crystals had the same form, that of a right prism with a rhombic base.

Since, therefore, the cavities, in sulphat of barytes, evidently contain the matter of that substance in a fluid state, it seems fair to infer, that the cavities in other crystallized minerals may contain their own matter in a similar state. This I have lately ascertained to be the case with fluor-spar. About two months ago, I succeeded in forming a partial rent in a crystal of that mineral, containing a cavity with a fluid and moveable globule of air. The instant the rent took place, the air began to expand, and continued to do so, until the whole of the fluid was expelled from the cavity. The fluid appeared on the line of the rent, in the form of twelve distinct globules. These were tenacious, and of a hemispherical form. One of them was much larger than all the rest put together. For several hours after the fluid came out, there was no appearance of crystallization; but, next morning, a number of cubical crystals, aggregated in a curve within the margin of the largest globule, were distinctly visible. The crystals were completely immersed in the fluid, together with a few minute globules of air, which had come out of the cavity. The crystals daily increased in bulk, with a corresponding diminution of the fluid; but a fortnight elapsed before the crystallization of the fluid was complete. Even then a slight degree of moisture could be observed on the surface of the crystals, and also on the space included within them; and this moisture still remains. Some of the globules, which are extremely small, still remain in a fluid state. When the crystals attained such a size as to come near the surface of the fluid, the edges of the upper surface of some of them gradually rose above it, and these have now the form of an inverted four-sided pyramid, a form which is often assumed by muriate of soda, when slowly crystallizing.

The elasticity of the globule of air in the cavities of all the crystals I have yet examined, is evidently great, for whenever a rent was formed, the globule, however small before, always expanded to such a degree, as to expel the whole of the fluid. In the cavity of fluor-spar above mentioned, the globule of air expanded to more than the size of the cavity, for a part of it even escaped along with the last portions of the fluid. Indeed I have repeatedly found the elasticity of the air to be so great, that when a direct opening was suddenly formed into some cavities of sulphat of barytes, the whole of the fluid was blown out in an instant, not a trace of it being left behind.

I have observed a very curious property of the globule of air in the fluid cavities of various minerals. These globules, whenever they are moveable, always occupy the upper part of the cavity in which they occur; but if the end of a heated wire be made to touch the surface of a crystal next the under side or end of a cavity, the globule of air immediately descends to it, and that, too, with a rapidly accelerating motion. On removing the wire, the globule immediately ascends to its former position, but with a uniform motion. Perhaps you can afford an explanation of this phenomenon. I am, &c.

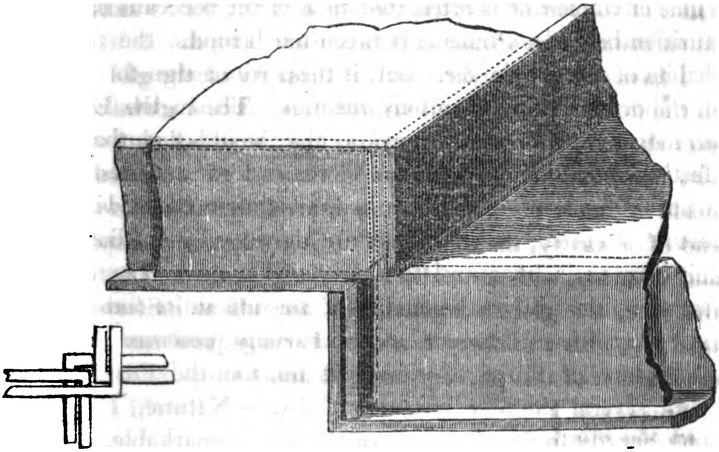
EDINBURGH,
4th May 1828.

On covering the Roofs of Houses with Plates of Iron. By M. E. CARTER. In a letter to the Editor.

SIR, *Exeter, April* 8. 1828.

My attention has been recently directed to some observations in the last December number of the Edinburgh New Philosophical Journal, upon my scheme for covering the roofs of buildings with plates of cast-iron. Your principal objection is founded on an apparent imperfection at the junction of four of the plates, which does certainly, at first sight, appear as an obstacle to the success of the scheme, and is what in truth occasioned me to hesitate, before I determined to adventure any thing upon the matter; but, satisfied upon more mature reflection, that whatever water might be driven into that corner, must ultimately be conducted to, and fall into, the lower plate, and from that plate to another in the like position, until finally led to the eaves or gutters, I determined to try the experiment, and had a set of plates cast and put upon a roof, the result of which was completely satisfactory; the experiment roof having, besides with others (since erected) withstood the violent hurricanes of last February, without the displacement of a single plate, or the admission of a drop of water.

The diagram here given, is a vertical section, at full size, made parallel with the side of one of the upper plates, through the lower; by examination of this, and the transverse section, I



think you will be satisfied of the impossibility of forcing any water over the corner of the lower plate.

In point of taste, nothing can be worse than the roofs of our modern dwellings, which, with what are termed hips and valleys, present a series of irregular pyramidal forms, intersecting each other in a most incongruous variety, indescribably disagreeable to the eye. The valleys also causing, in many cases, the nuisance of smoky chimneys, and sometimes an inundation of the dwelling, upon the breaking up of snow.

In the application of this project to the covering of dwelling-houses, the upper parts of which are usually divided into rooms of moderate dimensions, it will be found that no trussing is required, and consequently there is a considerable saving in timber and labour, the partitions being sufficient support for the rafters whereon this covering is laid. I am, &c.

Notice regarding some extraordinary Lusus Naturæ in the East Indies. Communicated by Lieutenant James Edward Alexander, 16th Lancers, M. R. A. S. Cor. Mem. S. A. E. &c. With a Plate.

It has often been remarked by travellers, that, in eastern countries, deformed individuals are seldom or never met with. This circumstance is attributed to a variety of causes, as parturition being less difficult between the Tropics, the temperate habits of the people, &c.; but, if those who assign these reasons for abortions being of unfrequent occurrence in the East, were to inquire a little more carefully, they would find that imperfectly formed beings occur as often in eastern countries as in our own. Why, then, it will be asked, are they not met with? The answer to this is short. They are destroyed immediately after birth by their unnatural mothers, and commonly by placing a small opium pill in the mouth of the infant. Some of these unhappy beings, however, are occasionally preserved; and, as it fell to my lot, during my peregrinations in the East, to meet with several singular instances of Lusus Naturæ, I now propose shortly to describe some of the most remarkable.

I. During a march from Jaulnah to Arcot, I halted one day at the town of Rachootee, in the Ballaghat ceded districts. I was sitting at the door of my tent, which was pitched in a mangoe tope or grove, and was enjoying the cool evening breeze, (after the nice drying temperature of 105° and 110° during the day), when I saw a singular being of about three feet in height approaching me. He came up to where I sat, and, with a low salaam, asked my pardon, and solicited charity. On a cursory glance, he seemed to have his arms tied behind his back; but, upon desiring him to turn round, I found that he had been deprived of these members by the hand of Nature.

This singular little man was arrayed in a pair of loose white long drawers, with a sash; his body was naked to the waist; over the left shoulder he wore the *zunar* (the sacred cord of the Hindoos), and on his head was an ample turban. His age seemed to be about thirty; his head was of the usual size of an adult, and fully developed, and well formed in every respect. The scapula or shoulder-blade of the right arm was in its proper place, but the arm itself was wanting. The left arm was entire, including the os humerus, fore-arm and hand; but, what was most extraordinary, the whole arm was enveloped in the skin of the trunk, no part of it being visible, except the third phalanges of the fingers, which protruded close to the left pap. This arm (the left) was doubled back, so that the elbow touched the vertebræ. No cicatrix was perceptible on any part of the external cuticle, and the motions of the incarcerated arm at the will of the abortion were most wonderful. The thorax was very considerably distorted, and the abdomen was scarcely observable, as the short ribs rested on the pelvis. The left leg was four inches shorter than the right; and, to sum up the peculiarities of this singular being, there were the rudiments of a sixth toe on both his feet. Deprived of the use of his arms, he was obliged to feed like a brute, by thrusting his head into the vessel which contained his food; and, unlike some individuals of a nearly similar malformation, he derived no assistance from his feet in performing any function, except in being able to run with tolerable speed, but in a most ludicrous and surprising manner.—Plate I. Fig. 1.

II. In the Bazar at Arcot, there was a boy who, at a little distance, might easily have been mistaken for a dog; in fact, he was commonly called by the Musselmans *chokra sug sa*, or the dog-like boy. He walked on his hands and feet with his head thrust forward, and was unable, without considerable pain, to erect his body to an upright posture. The cause of his extraordinary gait was, that the pelvis being much distorted, the femoral bones were so placed in conjunction with it, as to cause his legs to be at right angles to his body. His knee-joints being stiff, and his legs being much shorter than usual, his body is quite horizontal, and he walks about with seeming ease to himself. He is about fifteen years of age.—Plate I. Fig. 2.

III. There was also at Arcot a little mat-maker, the formation of whose hands and feet was very peculiar. They were like the forceps of a crab, the skin covering three and two of his fingers and toes, and causing them to resemble claws. He plied his vocation with hands and feet, and produced as neat work as his brother mat-makers. Plate I. Fig. 3.

IV. I have frequently seen in India four legged chickens, double-headed pups, &c. but these monsters sink into insignificance when compared with the one I am going to describe, which is a quadruped, the produce of a sow, and littered at Kurnoul not long ago. The mother brought forth a litter of pigs, all of which were naturally formed, with the exception of the monster in question, which came into the world alive, but survived only a short time after its birth; and is now preserved in spirits, and in the possession of Captain Wallace of the Staff of the Madras Army. It exhibits the following extraordinary appearances in its conformation.

It is half a sow and half an elephant. In addition to the ordinary rostrum or snout of a hog, a prehensile proboscis projects from the bottom of the forehead; the monster has likewise got the pendulous ears peculiar to the elephant; and the nostrils are seated at the extremity of the elephantine proboscis. This non-descript is a Cyclops, for, upon raising the prehensile trunk, a single and well formed eye is observed, the size of which is considerable in proportion to the bulk of the monster; the lower eyelid is furnished with cilia; the eye is concealed by the trunk, and is not perceived until the proboscis is raised, which forms as it were the upper eyelid. The length of the body of the monster is upwards of a foot, and is thinly set with hair; the tail is that of an elephant, there being setæ or bristles at its extremity; in the upper jaw are a couple of canine teeth: the testes, as in the genus *Elephas*, do not protrude from the abdomen; but this is no distinctive mark, as the young of most animals have them similarly situated.—Plate I. fig. 4. 4.

The only way of accounting for the production of a monster like the foregoing, is the almost inexplicable doctrine of sympathy,—the imagination of the mother may have been fearfully excited when in a state of gestation, by being nearly trodden upon, or injured, by an elephant, of which there are several at the birth-place of the monster.

ROYAL MILITARY COLLEGE,
SANDHURST, 1*st May* 1828.

On the Fires that take place in Collieries; and particularly on the Recent Fires in the Whitehill and Polton Collieries, in Mid-Lothian; and South Sauchie Colliery, in Clackmannanshire. By ROBERT BALD, Esq. Mining Engineer, F. R. S. E. M. W. S. &c.* Communicated by the Author.

IN the ordinary and arduous operations of collieries, there daily occur many difficulties; such as, an excessive extra quantity of water which requires to be drawn to the surface; bad roofs, which must be constantly guarded and secured, for the safety of the adventurers and miners; and crushes of the coal pillars, and of the whole superincumbent strata, which frequently resist every attempt to stop their progress.

Besides these, there are others, such as the constant flow of carbonic acid gas common to every colliery, by which many lives are lost, and the production of carburetted hydrogen, peculiar to collieries in particular districts. In Scotland, the carburetted hydrogen is most abundant in the Ayrshire and Glasgow Collieries; in England, in the districts of the rivers Tyne and Wear, in the counties of Northumberland and Durham. The first of these gases is named by the miners in Scotland, Choke-damp, Black damp, and Styff; the latter is generally named Fire, or Fire-damp.

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* Read before the Wernerian Natural History Society of Edinburgh, 19th April 1828.

The first species of gas is comparatively easily guarded against and avoided; the latter is subtile,—the very pestilence and bane of the miners,—springs into action as instantly as the lightning of heaven, producing the most fearful destruction, and the most appalling catastrophes, sweeping before it men, horses, and materials, like chaff before the wind, in one mingled mass of horrible ruin.

These disasters, though violent and dreadful, are happily of short duration; and the bold, unyielding, and persevering spirit of the miner, in a short time repairs the wreck; the labours are resumed as if no such disaster had taken place, and that with a degree of cheerfulness which has greatly surprised every one.

There is, however, an accident of a different kind from these before mentioned, which, though in general very slow in its progress, is most difficult to overcome, because, though slow in progress, it goes on unremittingly, gains strength hour after hour, and day after day, and, in many instances, puts the skill and persevering exertions of the miner to defiance;—this is, common burning fire in the coal mines, the ignition of the coal.

This fire arises from three causes: 1*st*, From the flame of a blower in the coal, from which the carburetted hydrogen issues with such violence, and in such quantity, that the noise is fully louder than the noise of steam issuing from the valve of a steam-engine boiler, when fully opened, and steam in abundance within the boiler; or, by the blast of an explosion, which is a magazine of blue and white flame, of intense heat, which sets fire to the small coal-dust of the roads in the mines; for this fiery blast never sets on fire the solid coal, though the blower does so in some instances; 2*dly*, From spontaneous ignition, which is the most common, arising from the decomposition of pyrites amongst the coal rubbish; for, however abundant the pyrites be among the solid strata, and though in contact with water, no decomposition takes place, but, in the loose rubbish, the contact of air will soon produce fire, particularly if aided by the contact of water or moisture; 3*dly*, From accident and inadvertency by the contact of common fire with the solid coal, or with the coal rubbish.

For the extinguishing of these fires several methods are in practice. In some instances, the fire, if not of great extent, or only very recent, can be put out by throwing water upon the burning mass; but if pyrites abound, the application of water will, to a certainty, increase the evil. Nevertheless, it is often necessary to run this risk; and, when the fire is extinguished, to take measures for preventing a recurrence of the accident.

If the fire can be approached, the effectual plan is to shovel it out, and send the burning materials up the pit to the surface. In this service the miners are sometimes dreadfully scorched; but what is more dangerous are the deleterious vapours arising from the fire, which are very much mixed with the fumes of sulphur: these often so much overcome them, that they drop down, and they are then dragged, like dead men, to the fresh air, where generally they soon recover; but the effects are such, that they often suffer in their health for years after. If, however, the miners lie, for any considerable time, in such air, very few of them can be, by any means, reanimated.

The next plan is to choke the fire, as it is termed, by shutting up, with clay-puddle, every pit and mine connected with the burning mass. This, in many instances, succeeds; but we have seen instances where such means were ineffectual, and the fire continued to increase, by drawing a supply of air to support combustion through cracks and crevices, which are sometimes open from the surface, and are unseen.

When the fire exists near the dip part of a colliery, where the drainage is performed by machinery, the fire is easily extinguished by stopping the machinery, and allowing the water to grow up. If the fire is toward the rise or out-crop, this circumstance suspends all the colliery operations, until the water is again drawn off by the machinery. On the other hand, if the rubbish is full of pyrites, the spontaneous ignition is greatly increased by the water hastening the decomposition of the pyrites. Hence there is, at best, but a choice of evils.

If coals on fire have a level free drainage, it is, in most cases, impossible to dam up the water; and the only resort is, to extinguish the fire by smothering, and preventing the access of air.

In the collieries in Staffordshire, particularly in the coal named the Ten Yards Coal, actually thirty feet thick, and which I have frequently examined, spontaneous ignition is very frequent. The miners term it, in that district, the *Breeding Fire*, because, without any visible contact of actual fire, the coal rubbish becomes red hot.

Fires in the mines there have been for long an every-day occurrence; and sometimes such is the intensity of the fire in so thick a coal, that near the surface it burns with a white heat, melts the argillaceous schistus into glass, and converts the pure argillaceous earth, or fire-clay, into a substance similar to the hardest porcelain. But what is more remarkable, the common argillaceous ironstone frequently assumes the appearance of regular basaltic columns, of about an eighth part of an inch in diameter. This aggregate mass is so hard, that it is found equal to any material for making turnpike roads, and is so applied.

At Bilston and Dudley, in Staffordshire, these fires at present exist. At the latter place, I visited a garden of considerable extent, where I saw, from the influence of the subterraneous fires, the snow melting as it fell upon it; and not only very early crops of vegetables are raised there, but no less than three crops of them in the year. Of this garden there is an account in the Caledonian Horticultural Society's Transactions, sent by me to my friend Mr Neill, our secretary; and it is worthy of my particular remark, that although the fire is near the surface of the earth, all the beneficial effects of moderately increased temperature are found, and no detriment results to the growth of vegetables. From this circumstance legitimate conclusions may be drawn, as to the existence of central fire in the earth. This theory I have long supported, and I think it can be substantiated by sound and philosophic arguments.

In the early periods of working this coal, the spontaneous ignition very much vexed the miners. They had no proper system then of working so thick a coal, on which account they sunk a great number of pits within a few yards of each other; they then wrought the coal from the top of the bed to the pavement, like the frustum of a cone, very wide at bottom; they made no extended works, as they were so liable to take fire, but, abandoning one pit, instantly commenced another; and over the top of each deserted pit, they built a cone of brick-work, like a bee-hive, to prevent the air having access to the coal. Many of these pits are to be seen near Dudley, in a circumscribed area, very close to each other, not unlike the ant-hills found in forests.

In the progress of mining, the working of this celebrated coal has been much improved, and extensive workings are carried on by one pit. This regular and scientific mode is represented by the diagram, fig. 1. Plate II.

When a pit is sunk to the coals, mines, termed *Headways*, are run from both sides of the pit, in a level course direction as a main road *a*, *a*, for bringing the coals from the miners to the bottom of the pit, and at regular distances, according to the system pursued by the mining engineer who directs the colliery operations; openings are made in the coal, next to the pavement, or rock, on which the coal-bed rests, which openings are about eight feet wide, and seven feet high: these are termed *bolt-holes*, and are marked *b*; from these bolt-holes the working of the coal is extended, and by these the excavations, marked *c*, are made of from two to three hundred feet in width and breadth, and there is left around each excavation a strong barrier of coal, as represented in the figure, to insulate the excavation.

As much small coal rubbish, mixed with pyrites, is left within the excavated area, if the free access of air were permitted thereto, spontaneous ignition would soon take place; but this is commonly effectually prevented by placing a stopping, as it is termed, in the bolt-hole. At first this was done by stones and common rubbish, but this was in many instances found to be ineffectual, and the most secure method is proved to be, by building two walls across the bolt-hole, composed of loose stones, at some distance from each other, and filling up the space betwixt them with mine dust, that is, with the dust of calcined ironstone, produced at iron works. This, aided by the moisture of the mines, becomes a solid mass, quite impervious to air, and is not injured by the crushing of the strata, as is the case with stone walls, which are crushed into a loose powder, through which air will pass. By this simple method, spontaneous ignition is now generally prevented in the Dudley district.

In the north of England collieries, namely, those on the rivers Tyne and Wear districts, where the coal occasionally takes fire, the danger is exceedingly increased by the presence of hydrogen gas, which sometimes accumulates, then fires and explodes at the burning mass; accumulates again, and goes off at regular intervals, loud as the thunder of heaven, when the bright blaze of conflagration is succeeded by a darkness so intense, that, in figurative language, it may be felt. This singular feeling is quite familiar to those who traverse mines. In this case there is no alternative but to choke the fire, by sealing up, as it were, the shafts or pits. This is no easy matter, for the shaft, in many cases, dare not be entered by any living creature, without almost instant death, and to cover the mouth of the pit would be quite ineffectual; the plan, therefore, is to lower a strong wooden scaffold, by cables or chains, to a considerable depth down the shaft, and then to throw many tons of plastic clay down upon it at random, which in the fall makes a solid puddle; but if there is water in the shaft, a precaution is necessary, otherwise the water accumulated above the scaffold would in all probability break the chains or cables. To obviate this, a long pipe requires to be put through the scaffold, recurved like a shepherd's crook at the top, in order to allow the water to descend, without the admission of air.

In other cases, where the fire is in the coal-dust of the roads, and flaming, and no hydrogen gas is apprehended to exist near the fire, small extinguishing engines, fitted for the mines, are used, and frequently with good effect; but when the engines cannot be applied, the flame has been in some instances extinguished by the power of sudden concussion, produced by the firing of cannon as close to the flames as possible. This effect is well known, and this method has been again and again proposed for extinguishing fires in buildings.

Such is a very brief account of the plans pursued for extinguishing fires in coal-mines,—a subject of deep interest to the proprietors of mines, and, in particular to the mining engineer, who is often called, in such cases, upon duty, has to risk his life, and the lives of his assistants, and to use every means which science and practice can suggest, to extinguish the fire. This subject is not only very interesting to the inhabitants of Great Britain, but to the world at large; for, in such trying situations, men meet on common ground, and, with kindred feelings, are ready to afford every aid in their power, as in the storm and the shipwreck, when national distinction ceases to exist.

Of the fires which have existed in the coal-mines of Scotland, the chief are, those of Kilkerran in Ayrshire, the property of Sir James Ferguson, Baronet; Johnstone colliery, near Paisley, the property of Ludovick Houston, Esquire; Dysart, in the county of Fife, the property of the Earl of Rosslyn; Alloa, the property of the Earl of Mar, in the county of Clackmannan; Halbeath, in the county of Fife, the property of John Scott, Esquire; Bridge of Ort, the property of Lord Rothes; Wemyss colliery, the property of James Wemyss, Esquire, M. P. in the county of Fife. Many others, less remarkable, were comparatively easily overcome and extinguished.

Kilkerran Colliery is situated on a hill; and the drainage is effected by a day level, which lays dry several beds of coal. It is said this colliery was set on fire by some herd boys, who were amusing themselves with a fire they had kindled at the mouth of the pit. This fire is reported to have existed for more than a century; for it appears, in some of the oldest maps of Ayrshire, published in the beginning of the last century, that this spot is named the *Burning Hill*, which name it retains to the present day.

Every attempt to extinguish this fire has proved ineffectual, as both water and choking by bad air has failed.

The fire was for some time confined to one bed of coal, the working of which had to be abandoned; but, in order to have the produce of coal from this colliery, the workings were pursued in a coal under the one which was burning, and I was informed by my friend, the late William Dixon, Esquire, of the Calder Iron-works, one of the most experienced and successful miners of his day, that he surveyed the coal which was working under the burning mass, where he found the miners in a heated atmosphere like an oven; that the drops of water which fell from the roof were scalding hot, and the candles were melted by the heat in the mine. In some places, at the surface, the argillaceous schistus had been melted into a glass or slag. This shews with what resolute and fearless determination mankind at times pursue their labours, and with what danger they often earn their bread. This burning district of the colliery has been long abandoned, and the mining operations are now carrying on in the valley of the River Girvan to the south, clear of the burning. From the heat which existed in this hill, and its diffusing itself equally at the surface, it was observed during the winter, that the snow which fell melted immediately over a considerable extent of the surface, and that the herbage in winter was of a lively green. This induced the proprietor to convert part of this ground into a nursery, for the rearing of forest trees; and it succeeded admirably, as the trees grew vigorously, and very quickly; but when they were removed from this genial clime, produced by the subterraneous fire, to exposed situations, the severity of the climate killed the plants, from the suddenness of the change of temperature.

This circumstance also shews how the internal heat of the globe may diffuse itself in high latitudes, near the surface, and produce in some degree the favourable effects of the climate of the equatorial regions, in place of injuring vegetation, as we would very naturally imagine.

The Johnstone Colliery took fire by spontaneous ignition above twenty years ago. It consists of five distinct beds of coal lying close to each other, forming as it were one bed of coal, constituting a thickness of above forty feet; and in one place, these five seams are overlapped, and constitute a thickness of about eighty feet, which is an anomaly in the British coal formation. It is also remarkable, that it is in a district abounding with hard compact greenstone; and the engine-pit, where the drainage of the colliery is effected, commences in a bed of greenstone at the surface, which is no less than 108 feet in thickness.

When this coal-mine took fire, it instantly burst into flame, and there being an open air-course betwixt two pits, it gained strength, and burned with uncommon fury. Figure 7th, Plate III. represents the situation of this mine with the two pits. The fire commenced at the point *a*, betwixt the two pits; the atmospheric air descended the pit *b*, and passing through the burning mass, carried with it an immense volume of smoke, which ascended the shaft *c*, and issued at its mouth, forming a column of pitchy blackness, which rose to a great height into the atmosphere, the air being calm. This had a terrific appearance: it continued in this state for some time, until this dense vapour was heated to the igniting point, when it suddenly burst into flame with a very loud explosion. This bright aspiring flame, as thick as the volume of the pit, was at least seventy feet in height, and produced a very fearful but sublime object. It instantly burnt down the machinery for drawing the coals at *d*. This flame could have been immediately suppressed, by covering over the pits *b* and *c* with baulks of wood and wet clay; but there were horses at the bottom of the shaft *b*, so that if they had shut the pits, the horses would have been instantly suffocated; on which account, the minds of all concerned were turned to the saving of the poor horses. The men, therefore, went resolutely down with the descending air at the pit *b*, slung the horses in succession, and sent every one of them separately to the surface, and then they themselves ascended. The two pits were then covered over; but as all hope of extinguishing the fire, either by water or by contaminated air, was hopeless, exertions were made to confine the fire to its circumscribed place, and stone-walls were built in all the openings betwixt the pillars and around the fire; which walls were made air-tight by a thick coating of lime-plaster. This has had the desired effect, and the burning has been confined within these bounds. This fire still continues, and an opening is kept at one of the pits, to allow the suffocating vapour to escape, otherwise it would contaminate the fresh air where the miners are working. When I visited this colliery a few years ago, I found the heat still very strong, as it issued from the opening left in the pit; and when examining the mines, I found the plaster upon the walls had very little warmth. I have no doubt this fire will continue to burn within these bounds for a long period of years.

I examined the wastings of another pit in this colliery some years after, where the process of decomposition had commenced. There I found the heat so great, that the miners were all of them working naked above the girdle, as the heat was to them exceedingly oppressive.

Dysart Colliery has been frequently on fire in the main coal, which is fully eighteen feet thick. One part of this coal contains pyrites, existing rather in a combined state with the coal, and not very visible to the eye. Many years ago it burnt with violence, and extended progressively to the outcrop near the surface, where the common blue schistus has been converted into a brick-red colour by the heat. This burning created much trouble and expence, and it was extinguished by insulating the burning coal from the main body of the coal-field, till the fire exhausted itself. It has now been extinct for a considerable number of years; yet, at the present time, when the coal-rubbish is allowed to lie in heaps of considerable thickness below ground, the incipient ignition is detected, and the rubbish has either to be drawn up the shaft, or spread very thin along the pavement of the mines. Great caution is daily necessary there, to prevent spontaneous ignition, which is soon discovered by a peculiar smell (well known to the miners), diffusing itself through the workings.

The Alloa Colliery took fire about twenty-four years ago, in the nine feet coal at Collyland. This was an accidental fire, occasioned by a candle igniting dry rotten prop-wood, which was in an old part of the mines, and of the nature of touchwood. It took place while I was traversing the wastes with my assistant. We made a very narrow escape from suffocation, as the ignition took place rapidly, and the smoke ascended the pit very soon after we came to the surface. Every effort was made to extinguish the fire, by closing up the pits and preventing the access of the air, but all attempts were ineffectual, and the burning continued for upwards of eighteen months.

As it was necessary to carry on the colliery, the miners were employed in a coal immediately above that which was burning; but it frequently happened, that, while they were working, and while their candles shewed no sign of bad or vitiated air, they dropped down lifeless, and had to be carried to the fresh air ere they revived. This was an anomaly as to the test of pure air familiar to the miners, and shews that this vitiated air arising from the burning, when mixed with the common air of the mine, will support the flame of a candle, but not animal life. This circumstance indicates what extreme caution is necessary when men enter mines where a fire exists, as their situation, in this case, is extremely dangerous, and therefore no person ought to enter such a mine alone, or even with a single assistant. A number should always go together, and keep at a short distance from each other, in order that immediate assistance may be given to the front men in case they drop down. In this colliery, I passed through a quantity of this deleterious air, not knowing that it was there. I had only one assistant, and we very narrowly escaped. Upon our coming to the surface, I found no bad effects; my assistant, however, suffered much, but recovered. I found, as is always the case, that the muscular energy of the knee-joint first fails; this feeling was very sensible, in this instance, with both of us.

The wastes or excavations of this coal were connected with the wastes in an adjoining estate. The subtile effluvium passed into this estate, and, at about a mile distant, ascended a pit, and killed the birds which were near its mouth.

After eighteen months, the fire became seriously alarming, and we then had no alternative but either to allow the burning to go on, or to drown the colliery, and render it useless until some after-period. This last was resolved on; the pumping engine was stopt, and as the growth of mine-water was comparatively slow, we brought a brook along the surface, and allowed the water to pour down the engine pit, where it fell in a cascade of about 300 feet in depth. By this plan the fire was extinguished, but the colliery remains drowned and useless to the present day.

The Hallheath Colliery took fire in a solid bed of coal, which was level-free, but had not been wrought. The crop of the coal was on a bank near one of the great pumping engines, and the red-hot ashes from the furnaces of the engine-boilers were inadvertently laid against this bank; these set on fire the coal, and the fire extended by slow degrees in a simple state of incandescence, and continued in this state for years. Its progress was only arrested by a slip of the strata, which acted as a barrier against the farther progress of the burning. This shews how easily, in some cases, even a bed of solid coal may be set on fire.

The Bridge of Orr Colliery was set on fire by spontaneous ignition, during the severe winter of the year 1812. It is a continuation of the thick coal of Dysart before mentioned. During this severe winter, many rivers in Scotland froze to their beds. The water of Orr, which passes the colliery, froze in this manner; and when a sudden rain and thaw succeeded the frost, the accumulated waters flowed on the top of the ice, and a considerable quantity ran down the colliery pits. This water caused a decomposition of the pyrites, the consequence of which was, that fire and flame were very soon generated. I was called upon this occasion; and as the burning was confined to a narrow space, the workmen, at great risk of life, shovelled together the burning coals, and sent them up the pits; and when they were unable to do any more from the extreme heat, and suffocating vapours, the remaining burning mass was smothered by covering it over with very wet puddle; after which the colliery operations were resumed.

The Wemyss Colliery was set on fire, a few years ago, by a quantity of small coal being accidentally laid over a brick-flue of an underground high-pressure engine. This fire rapidly extended, and has occasioned much trouble and expence. It has burned for at least three years; and as the burning mass was insulated, I think it very questionable if the fire is altogether extinct.

I was sent for upon this occasion, and was able to get very close to the burning mass. I found the men, who were attending and giving their assistance below ground, very much affected by the deleterious vapour; their faces were pale, and their eyes had a glazed or varnished-like appearance,—a circumstance I have frequently noticed in similar cases. Upon my returning to the bottom of the engine pit, I found the sulphurous vapours very much affecting my head; so much so, that I requested the men to tie me to the rope, in case I should have fallen during my ascent. The effects of this vapour produced a most violent headache, which continued three days. During this burning, many narrow escapes were made; and two unfortunate young women, who were carrying breakfast to their relations in the mines, fell victims to this most insidious vapour.

Having thus given a summary view and account of the chief fires which have taken place in the Scotch Collieries, I have now to state the particulars of the three recent fires, which have taken place in Clackmannanshire, and in the collieries of Mid-Lothian.

The fire which has taken place in the South Sauchie Colliery is in the old workings of the nine feet coal; which are of very great extent, and very ancient.

About three months ago, this coal was discovered to be on fire; and the suspicion arose from smoke issuing from the surface of the earth. This coal is not liable to spontaneous ignition, as it is very free from sulphur; and many conjectures were formed, as to the cause of the fire. But, after many minute investigations, particularly by examining those who last wrought in this district of the colliery, we found, that the fire had commenced not less than ten years ago;—a circumstance peculiarly singular, and which shews how very slowly this state of incandescence may go on without being discovered. Fig. 2. Plate II. represents the situation of the mines where the fire is. Although it was observed by some of the miners, that the snow, during last winter, soon melted at this place, they never once suspected that fire was the cause.

In the roof of this nine feet coal is a very valuable argillaceous ironstone, wrought by the Devon Iron Company, for their furnaces. For the working of this ironstone, they sunk a pit of about three fathoms deep, at the point *a*, Fig. 2. Plate II; and, in the course of working, they laid an accumulation of mine rubbish, as represented at *b*, by the side of the pit, and over the crop of the coal. This mine-rubbish took fire, from the small fires kindled by the miners upon it, and burned for some months, as is commonly the case with such heaps, without the least danger being apprehended from it; but it is certain that this was the cause of the present very alarming fire, which is now of considerable extent, and, if not extinguished, may extend over a mile of excavated coal; and not only so, but by making the rocks red-hot, may extend to the upper beds of coal, and occasion an excessive loss to the district. There is also a risk of it burning the coal-pillars in the middle of the pit *d*, and rendering the machinery erected upon it useless for draining the five feet coal-seam, which is situated thirty-nine fathoms under the said nine-feet coal.

This very hazardous situation of matters required instant and very decided action for extinguishing the fire; and, after all circumstances were weighed, it was found that water could not be applied, nor could it be effected by drowning, as the water would never reach this part of the colliery, even although the engines for draining the water were stopped. It was therefore resolved to run a mine all around the burning mass, to insulate it from the other parts of the colliery, and to allow the fire to exhaust itself within these limits. This operation is now in progress, and is represented by a plan of the colliery, Fig. 3. Plate II.

The rectangular lines represent the mine which is to be carried around the burning mass, along the pavement of the coal. In this mine, a puddle of clay, of from six to eight feet thick, is to be carried all round from the roof to the pavement of the coal; then, there is to be left an open air-course, of about five feet wide around; and upon the other side of this mine or air-course, a clay-puddle, similar to the former, and parallel with it, is also to be carried round; and the object is this:—when the burning extends to the inner clay-puddle, it may become heated; but the caloric, as fast as it is generated, will ascend to the surface by the mines *a* and *b;* and the other clay-puddle will, it is expected, effectually prevent the heat from extending to the coal-pillars on the other side. Besides, the air-course gives a ready access to the miners around the burning mass, to repair any breaches in the puddle; and if need be, water can be introduced, in the extremity of the case, betwixt the two puddle-walls. The small dots represent the fire or burning mass, which exists chiefly in the rubbish of the mine.

This is a very hazardous operation for the workmen, on account of the deleterious vapours; and, for their security, a pit has been sunk to the coal at *c*, in order that, as soon as the mine communicates with the pit, the fresh atmospheric air may descend the pit, and ascend by the mines to the surface; and we know that this determination of the air will take place, both from physical principles, and from experience. The workmen will then always descend by the pit, where the fresh air is going down, and thus secure to themselves, at all times, a safe retreat. Without this precaution the miners could not pursue their work in the mine. Hitherto the mine has gone on successfully, although with danger; and we have every hope that the enemy will be eventually subdued.

The Polton Colliery was discovered to be also on fire, in November last, in the wastes of the eight feet coal.

The air in this coal having stagnated, and become unfit for the respiration of the miners, a large circular iron grate was, (previous to the fire taking place,) suspended from the top of the pit containing burning coals, in order to rarify the air in the shaft, and produce a circulation, which had the desired effect, See Fig. 4. Plate III; but one day, some mischievous boys disengaged the machine at the top, from which the grate was suspended, it ran a-main, and set on fire some small coal basket-rods, at the bottom of the pit. This communicated fire to the dry coal-rubbish adjoining, and the burning has gone on slowly ever since. Water had been applied, but with little effect. Many attempts were made to shovel out the burning materials, and also to insulate the fire; but it increased to the extent of about sixty feet diameter, and was making such progress, that the directors of the works resolved to attack it boldly, which they did, by shovelling out the burning coals, and sending them to the pit-top. By perseverance, uncommon exertions, and the occasional application of water, they at last extinguished the fire, and the colliery is now in perfect safety. This was a most dangerous service, and very trying for the miners, from the scorching heat and suffocating vapours. Happily in this severe duty no lives were lost. There are many instances of fires having commenced in the bottom of coal-pits, from the hot ashes of the grate falling down and accumulating, on which account a large iron pan should be hung under the grate, to prevent this danger, or the pit bottom should be cleared of all rubbish, and a low wall of stone or clay built around. In short, we cannot be too cautious where the hazard is so great.

I regret, however, to mention, that two miners fell victims to the noxious vapours, about three months ago. Their names were Kerr and Davidson. They had gone down in a morning, to view the burning district; but having remained long, the overseer of the colliery, John Sommerville, became alarmed for their safety, and descended with two assistants, of the names of Ferguson and Brown, in search of them. The pit by which they descended is 300 yards from the pit in which the burning was; and in going towards this last pit, they found Davidson's body, which was yet warm, but all signs of life were extinct. They felt themselves growing feeble, from the influence of the contaminated air, and after deliberating, they resolved to return for more assistance; but they had not returned above five yards, when the bad air extinguished the lights; they then made every exertion to save themselves, and Ferguson made good his way, and escaped. Sommerville and Brown went onward, in the midst of the most horrible darkness and suffocating vapour; and as they proceeded, they came to the body of Kerr, which, from feeling, they found to be lifeless. Sommerville instantly concluded that they had deviated from the direct path by which alone escape could be made, as they had not found Kerr in their progress inward; they resolved, therefore, to retrace their steps, but they had scarcely determined to do so, when Sommerville's remaining companion Brown, said to him, " I'm gone !" and instantly fell down. Sommerville, for some while, crept on his knees and hands, but the muscular energy of the arms soon failed; he then crept on his knees and elbows, but made very little progress, from the extreme feebleness and relaxation of the system. He, however, resolved, as a principle of self-preservation, to keep in motion, as he was yet sensible that if he lay down he would in all likelihood perish. In this way he continued for about an hour and a half, and made only a very few yards progress. While in this most trying situation, such was his intense anxiety for the appearance of men for his relief, that he frequently imagined he saw the lights of candles, like twinkling stars; but his senses were such, that he reasoned with himself that this was all delusion. At last relief came to him, and he was carried out quite exhausted, by two of his companions. The four others who had come down, boldly and determinately went onward, and found Brown apparently lifeless. With great difficulty they carried him towards the pit, and immediately upon their coming to good and fresh air, Brown shewed signs of reanimation; and upon being drawn up to the pit top, he, in a short time, so far recovered as to be able to walk home, supported by two of his companions.

As there were medical gentlemen in attendance, the ordinary methods for resuscitation were tried with Kerr and Davidson, but without effect, and they found that Kerr had been seized with a locked jaw. The others who escaped were attacked with vomiting, which is a common consequence in such cases, and the only other bad effect they felt was violent headach,—which also is a common consequence.

Whitehill Colliery took fire from spontaneous ignition; and it is supposed, from investigations made, that this happened about three years ago, by water descending from a sand-bed in the alluvial cover, and moistening the mine-rubbish, which produced decomposition of the pyrites. About three months ago the burning became strong, and the manager of the colliery, Mr Dewar, having ascertained where the mass of burning materials was, with much promptitude and decision perforated the masonry of an adjoining pit, where he knew there was a sand-bed with much water, and having made wooden pipes, conveyed this water down the shaft to the pit-bottom: from that point he carried the pipes with the water horizontally through the windings and turnings of the mine, and poured the water upon the verge of the burning materials. This very dangerous service he accomplished in the most expeditious manner, and it does credit to his spirit and zeal. He saw, however, that although the water was poured upon the burning mass, night and day, it was impossible to throw it upon the great body of the fire. At this crisis I was sent for, and I was able, by keeping close to the fallen roof, to approach within a few yards of the fire, which I found burning like a furnace, and the superincumbent rock strata red hot. The hot air immediately above our heads floated full of smoke, and was insufferably hot, so that it was dangerous to raise up our heads, and we felt that the roof above us was considerably heated.

After considering all the circumstances of the case, we resolved to cut a mine, if possible, around the burning area; but after considerable exertion, we found this impracticable; and we saw in the course of this trial, that the roof had fallen to a considerable height, and that the fire had communicated itself to an upper bed of coal. The case then became critical and alarming; every circumstance of the mines was considered, in order to devise the best plan for extinguishing the fire.

The coal was level free, and the colliery had a drainage through other adjoining collieries; from this circumstance the discharge of the water could not be stopped by ordinary means. The eight feet coal, in which the burning was, is situated eleven fathoms above the splint coal; and the water of the eight feet coal descended the pits to the splint coal, and there discharged itself. To this lower coal, five pits communicated. We therefore resolved upon the following process to extinguish the fire. At each of the five pits, and at nine feet below the pavement of the eight feet coal, grooves were cut in the rock, two feet deep, in the opposite sides of the pit, and into these grooves logs of wood thirteen inches upon the side were laid as a floor across the volume of the pit; these were covered transversely with boards, and over this was laid a well wrought clay puddle eight feet thick; and in order that the accumulated water of the mines might be drawn off at pleasure, cast-iron pipes with valves at top opening upwards, were inserted through the scaffolding and puddle, in two of the pits toward the dip, and a rope from each of the valves was secured near the mouth of each pit. These pipes had a collar cast upon them, so as the pipe might rest upon the face of the scaffolding.

The section of the colliery is represented figure 5, Plate III; and the timber scaffolding with the clay puddle, pipe and valve, are represented figure 6, Plate III.

While the burning was going on progressively, the fresh air descended the pit *a*, figure 5, passed through the burning mass at *c*, and the vapour and smoke ascended the pit *b*, in a moderate volume and slowly. In this pit *b*, there was a stair for the men descending to the mines, and as this was the pit to the rise, or crop, the air, as a natural consequence, always ascended by that pit. But as the communication below the eight feet coal at the pit *b* had to be stopped, it was altogether impossible to accomplish this while the stair remained in it, and no man durst venture down one fathom without losing his life. It therefore became necessary to reverse the current of air, so that the fresh air might descend the pit *b*, and ascend by the dip pit *a*, contrary to its natural course. To effect this, a large iron grate, capable of holding nearly a ton of burning coals, was suspended by a chain in the shaft *a*; the pit *b* was then covered over at the top, until the shaft *a* became heated by the fire in the grate; then the scaffolding was quickly removed from the mouth of the pit *b*, and the reverse circulation instantly took place. The miners then with perfect safety removed the stair—cut off the communication to the splint coal at the pavement of the eight feet coal,—and this being accomplished, the grate with the fire, was removed from the pit *a*, and the circulation returned to its ordinary course. Meantime, the water being prevented from descending to the splint coal by means of the scaffoldings and clay-puddles, it accumulated in the waste, and at last came in contact with the burning coals and red hot-rocks. This produced a very unlooked for phenomenon; for the steam, of very high temperature, rushed with impetuosity directly to the pit *b*, where it rapidly ascended, and at its mouth formed a dense cloud of steam which rose to a great height, and was seen at many miles distant. This steam by degrees heated the direct air-course, which, at last, became as a heated steam-tube; and not only the steam, but free and disengaged caloric, issued from the mouth of the pit, pure and invisible at the surface, the steam only becoming visible after coming in contact with the atmospheric air, at some distance from the pit mouth: so hot were the steam and air that they singed the hairs on the back of the workmen's hands;— the consequence of this was, that this sudden transit of the steam and caloric encreased the fury of the burning mass, by drawing to it a great quantity of atmospheric air, from the dip part of the colliery; and for some days the fire encreased in fierceness.

In order to try the temperature of the steam and caloric, I hung down the pit *b*, a thermometer, of Fahrenheit's scale, the highest range of which was 232°; and upon drawing it up, I was astonished to find the mercury up at the top of the tube; so that the absolute temperature I could not ascertain. This happened upon the 8th day of March 1828. I requested Mr Dewar, the manager, to try the temperature frequently; and, upon the 12th of that month, the temperature had sunk to the boiling point 212°. The water now began to operate effectually, and we had the satisfaction of finding, upon the 14th of the month, that the temperature was reduced to 165°. These trials were made in an opening of the pit-covering, of about eight inches square. The temperature gradually decreased to the 7th of May *, when it was 85°. We then threw off the covering from the pit, which gave a free issue to the steam, conceiving that the cooling process would go on more expeditiously, but to our great surprise the temperature encreased rapidly to 108°, and on the 13th it rose to 109°. On the 14th, we again covered the pit, and left a small opening as before, when the temperature was suddenly reduced to 97°. It has since that day progressively gone downwards, and, on the 21st May, the last day on which I have a report of the temperature, the thermometer stood at 84°.

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* I have added the results down to the 21st of May, when this paper went to press.

As this subject is very interesting, the register of the temperature as taken by Mr Dewar is annexed.

We therefore conclude, that the fire is about extinguished, and that our labours will be successful. We now expect that the temperature will progressively lower by slow degrees, because there is a vast mass of heated rock, considerably above the immediate contact of either water or steam.

It has been a matter of physical investigation to show by what chemical action spontaneous ignition is generated in those coals where pyrites abound. Air and moisture seem to be indispensably necessary; and it is also requisite that the coal rubbish be of considerable thickness,—for, if it is only a foot or two in thickness, the decomposition will take place with a very small degree of heat, but fire will not be the consequence. In this case, it appears that the heat is dissipated the instant it is formed; whereas, when the heap is of several feet in thickness, there is a certain degree of pressure, and the heat, as it is formed, accumulates. This accumulation of caloric hastens the more rapid decomposition, when heat is also more rapidly generated, and that to the point when actual ignition commences. The heat and fire which are generated in wet hay, seem to depend on similar circumstances; for, without accumulation and pressure, actual fire will not take place. As to the chemical action, several principles may be acting, namely, the decomposition of atmospheric air, when the iron of the pyrites seizes the oxygen of the air, and sets the latent caloric free; the oxygen and hydrogen of the water may highly contribute to encrease the temperature; and we know that it is a common occurrence for the coal rubbish, which is mixed with pyrites, at the mouth of pits, to take fire from the same causes; but depth and pressure are always necessary to produce the result.

What I have thus narrated, and explained by diagrams, shews the risk to which mines of coal and miners are exposed; in particular the latter, who are brought into the most trying situations, surrounded with darkness and the pestilence,—where the mind has full time to contemplate the danger, and the approach of death; and when the thought of home, of a wife, and of children, touch the heart with the most painful and most intense solicitude: a situation altogether different from that of our brethren who are surrounded with death, in the fury of battle, or in the overwhelming storm of the uplifted ocean. In these last cases, the hurry of action, and the necessary continued exertion, give but little time for the mind reflecting on approaching fate, or on the ties of friendship, or of home, and its endearments.

Such casualties in coal-mines as I have described, shew the necessity of great watchfulness to prevent the generating of fire; or, if generated, of preventing its becoming irresistibly powerful; and also, how necessary it is to act in all cases with prudent decision, having, at the same time, in view a due care for the lives of the workmen, who, in every instance, when required, go with cheerful alacrity into danger with those who conduct the necessary operations.

To the laborious and hardy miner we owe much; not only, as regarding many of the comforts of life, but also as regarding their direct influence in increasing our national prosperity as the greatest manufacturing country in the world.

EDINBURGH, *May* 22. 1828.

Register of the Thermometer, taken at Whitehill Colliery, by Mr Dewar, the Director of the Works.

1828.	
Mar. 8. Above the reach of the Thermometer Scale of Fahr.	
9. Do.	
10. Do.	
11. Do.	
12. This day the Pit was covered, - - -	212°
14.	165
15.	160
17.	140
19.	137
20.	134
22.	130
23.	128
25.	121
28.	118
April 1.	115
4.	112
6.	109
8.	108
11.	106
14.	104
1828.	
April 18. Pit still covered, . .	100°
21.	97
23.	95
26.	93
28.	92
29.	90
May 2.	88
5.	87
6.	86
7.	85
Same day covering removed from Pit, - - -	108
10.	108
13.	109
14. This day the Pit was again covered, - - -	97
15.	94
16.	92
17.	89
19.	87
21.	84

Abstract of a Memoir read before the Wernerian Society, giving an account of Experiments directed to ascertain the Principles of Attraction and Repulsion in the Lunar Rays, &c.; a Description of several Varieties of the Instruments constructed for that purpose; and some Applications of the Observations made, as illustrative of other Subjects. By MARK WATT, Esq. Member of the Wernerian Society, &c.

THIS paper commenced by some remarks on the unsuccessful attempts that had been made, to determine whether the lunar beam had any calorific properties or not. And, laying this subject altogether aside, the author considered it more probable, that he might succeed in exhibiting, with sufficient certainty, the attractive influence of the moon; a principle which it was generally acknowledged to possess, from the coincidence of its monthly revolutions with the flux and reflux of the sea. The received calculation also being, that the attractive power of the moon upon our globe, when contrasted with that of the sun, was as 10 to 3, from her greater approximation to the earth.

The different forms of the instrument used for making observations on the attracting and repelling powers of different degrees of light, were constructed on the same plan, with a view to the greatest specific lightness, and the least possible friction, that *motion* might be produced by the most delicate impulses of light.

About 6 inches of the opaque part of the quill of any feather of a suitable size, was used as a balancing bar, which was made to revolve on a fine steel point, by means of a small agate capsule inserted into an aperture made in the quill, at about ⅓d of the length of the bar from the point to which the discs were attached. No fixture was used for the cap, the elasticity of the medullary part of the quill holding it with sufficient firmness. The discs being affixed to one extremity of the quill, were balanced by any small weight at the other, and they traversed like a compass-needle.

The following substances were tried: A circular piece of dark coloured velvet, about 4 or 5 inches diameter, stretched on small quills; having 25 grains weight of magnetic steel-filings rubbed over its surface. Two or four of the illuminated tops of the smaller caudal feathers of the peacock (Pavo cristatus), with their dingy sides (which are little attracted by light) applied to each other, formed another kind of disc. Their planes were placed perpendicularly, and they were stuck into the end of the revolving quill. They were formed into a convenient size, by cutting off the straggling filaments of the feathers. One disc was made of gold, and another of silver leaf. They were formed by bending a piece of very fine silver-wire, of about the thickness of a hair, into a circle of three or four inches diameter. The wire, after being attached by its edge to the end of the quill, was wetted by a little water, in which a small portion of gum arabic was dissolved. The circle was placed upon a leaf of the gold or silver which adhered to the wire, and the corners of the leaf were then cut off.

The other substances were gold-beaters' leaf; very thin paper, coated with lamp-black; and thin laminæ of mica.

All these were successively put under a hemispherical glass-cover, placed upon a marble slab, and secured from any current of air, by being surrounded at the edge by a layer of wax or putty. The effect of light was also tried upon them under the exhausted received of an air-pump.

Effects of the Light of a Candle.—The first experiments made upon these bodies, to ascertain in some measure how far they were affected by the attracting or repelling influences of light, were by the flame of a candle; all other sources of partial light or heat being excluded.

The velvet disc, with the steel-filings, rendered magnetic, moved to the light of a candle at the distance of 1 foot from the edge of the cover. It turns its edge to the source of light, and consequently its plane nearly parallel to the rays.

The discs made of the feathers were moved by the candle at the distance of 3 and 4 feet, measuring from the flame to the point of suspension. A broad caudal feather of any of the gallinaceous tribe, if suspended by a fine filament of silk from the top of the cover, and balanced horizontally, with its flat sides opposite to the sides of the cover, will indicate the attractive power of the light at the distance of from 4 to 6 feet. They also traversed 5° either way to the influence of a powerful horse-shoe magnet, when placed so as to rest against the glass, the hand being quickly withdrawn.

The feathers generally begin to move slowly; in a few seconds they uniformly turn the points of their filaments toward the source of light, and their sides being parallel to the direction of the rays; and whenever they assume this relative position they rest. If the flame is placed opposite to the tips of the feathers at once, they move little, or not at all. If the rays of light are made to fall upon their planes, at angles of 40°, 90°, or 150°, they will traverse only to the extent of these degrees, and then remain stationary.

The gold-leaf, for the first hour or two after it is formed into a disc, and put under the cover, shews extraordinary sensibility to the influence of light. It indicates the effects of the light of a candle at the distance of from 15 to 20 feet from the flame. If not kept in the dark, and *in vacuo*, it soon loses this susceptibility; and, in six or eight hours, will not move at a greater distance from the flame than two feet.

The gold leaf always turns the edge of its disc to the light, in whatever position the candle may be placed.

The silver leaf is equally sensitive to the impulses of light, and never loses this property to the same extent as the gold. If thoroughly dry, and placed *in vacuo*, it indicates the influence of light, when 20 and 25 feet distant from the flame of a candle. Several of the leaves tried, whether kept *in vacuo* or not (if preserved from the light), when exposed to the attractive and repulsive properties of the rays issuing from the flame of a candle, always moved toward the light, at a distance of eight and ten feet. The silver leaf has a movement peculiar to itself. It first turns the front of its disc, and then its edge; and this movement is often so constant that it will oscillate for hours in an arc of 90°. When it has lost part of its susceptibility to the impressions of light, it is so attracted as to move till its disc *confronts* the source of the light. In this state, it loses its vibratory motion, and takes a minute or two to traverse 45°.

The gold-beaters' leaf moves at the distance of six feet from the flame. It turns its edge to the point from which the light emanates, and then rests.

Very thin paper, coated with lamp-black, or gilded with gold or silver-leaf, and varnished with spirit of turpentine, when the disc is about five inches diameter, move, by the influence of the light of a candle, at the distance of three and four feet.

As the light passed through the glass of the cover, which would intercept any degree of heat, whilst it admitted the light, and as the movements begin generally in a few seconds, there is no reason to believe that any increment of heat can have any share in producing the motions.

All these bodies, however, move to the influence of heat, when it proceeds from a *given point*, at various distances. Yet the effect of heat is evidently very inferior, in point of power, to the influence of light.

A piece of coal, for example, two inches square, ignited to red heat, when presented to the velvet disc with the filings, only excites it to move towards it, though held close to the cover; but if it is exposed to the clear rays of the sun, during summer, as soon as it has absorbed a certain quantity of the rays, it is strongly repelled, and will continue, when first made, to revolve for hours without intermission, performing each revolution in about 5″. They all turn their edges to the point from which the heat proceeds.

Effects of the Lunar Beam.—As the candle used in trying the effects of light on these bodies was of a moderate size, and as there appeared to be little difference between its illuminating power, at 15 or 20 feet from the flame, and the light afforded by the moon, when nearly full, it did not appear to the author unreasonable to expect, or surprising to find, that the discs were affected by the influence of the lunar rays, in nearly a similar manner. They were made the subjects of experiment both in the open air, under the cover, and in a room with the windows shut. When tried in an apartment, the window was darkened, and they were made to rest (by moving the stand a little), in such a position that the rays of the moon, when admitted, fell upon the discs nearly at right angles to their planes. They all turned their edges toward the luminary, and their planes nearly parallel to the incidental beams; and they frequently maintained this relative position for hours, moving slowly and regularly, by following the moon's apparent course, like the shadow of the gnomon of a dial.

The silver-leaf only continued a vibratory movement, but the arcs of vibration were evidently regulated by the position of the luminary in the hemisphere.

The movements of the feathers, and of the discs made of the gold and silver leaf, are the most constant and decided. The tips of the feathers are always attracted to the moon. And they have frequently been observed to commence their motion a few seconds after the beam has been allowed to fall upon them, in whatever angle their planes may have been resting, in relation to the incident ray. They have traversed, occasionally, 170° in a minute; and when the tips of the feathers came nearly opposite to the satellite, they stopped. It is only those feathers of the peacock that have a greenish hue when we look down upon their surfaces, that seem to be most attracted to the light of the moon. Those feathers where the bright purplish colour prevails, evince a more uncertain effect. These instruments will stand for hours in a room without moving, if placed in a situation where the beams do not impinge upon them.

These experiments have been often repeated, as opportunities occurred, for the last six months, and with every possible precaution. And there appears to be the greatest powers of attraction and repulsion in the moon's influence, from the time she has completed her first octant, till she is in quadrature or gibbous. There seems less attraction when she is full, and this may arise from the moon's being then in opposition, and the light must be reflected from it at that time almost directly against the light of the sun; whilst, when passing through her other phases, her reflected light will cross the light of the sun at acute or right angles.

It is not mere motion that has been observed in these instruments, but a movement evidently regulated by the source from which the light is emitted.

In performing these experiments, attention must be paid to the following circumstances: The cover used should be large, thin, and purely transparent; a card should be placed in the centre of the stand, divided into quadrants and points, to mark the progress of the revolving bar; regard must be had to great specific lightness, and the discs must be kept perfectly free from damp. Care must be taken, also, that the capsule is fairly placed on the pivot, which ought to be very fine. Every source of partial light and heat ought, as far as possible, to be excluded. And the instruments must be kept covered from the light some hours before they are used, as they will not move to a subdued degree of light if they have been exposed to a greater. Their sensibilities are considerably blunted for a time, if exposed to powerful light. We must also keep at some distance from the instrument when making the trials, as the heat and electricity that escape from our bodies are a source of attraction. All these bodies are much influenced by the solar beam. But nothing yet observed, if used in *equal weights*, moves so regularly as the magnetic steel to the sun's influence, which is affected in a way peculiar to itself.

Two causes are assigned for the phenomenon, that all bodies of sufficient specific lightness, having two flat sides approaching to planes, and free to move, turn always the edges of their planes to the source of light, and their planes parallel to the line of incidence. One of the causes appears to be a sort of elective attraction, which light, like electricity, has for the points or edges of bodies. The other reason is, that all bodies kept excluded from light, are, when exposed to it, first attracted by it; and when, from their colour or opacity, they have absorbed a certain quantity of the rays, are then repelled by it. The rays of the sun evidently soon repel all the substances mentioned; and when they turn their edges, they are in that position where they receive the least possible impulse from the rays. As a vane is turned by the mechanical force of a current of air, these instruments are turned by the repelling power of the beams of light. Bodies, quite transparent, are not taken into the account. The silver leaf is a half exception to this general law, but it is almost colourless and polished, and therefore absorbing but a small portion of the light, and quickly parting with it; it assumes a vibratory motion, first turning its plane, and then its edge, to a strong light, and thus continually moving in the arc of a quadrant. To a feeble light it stands with its plane confronting it.

The motion of the feathers seems chiefly to be occasioned by attraction. And as each filament of a peacock's feather, of the size used, has about 4000 piles upon it, each disc, at a moderate calculation, would present about a million of points to the light. These facts agree with some principles generally received, as establishing many coincidences between the phenomena of light and electricity.

Some farther observations were made on the effects of the rays of light on bodies of different forms. While bodies having planes, turned their edges towards the source of the light, and their flat sides parallel to the line of incidence, bodies of a concave shape vacillated continually in an arc of from 5° to 45°, according to the intensity of the beam of light. Bodies of a cylindrical form, crossed the line of incidence at an angle of about 25°. Transparent lenses (as of amber) keep their axes parallel with the incidental rays. And spherical opaque bodies, when nicely suspended or balanced, have the tendency to revolve continually when the beams of the sun fall clearly upon them.

Some applications were made of the phenomena described, as farther elucidating facts already known, as the attraction of the leaves and petals of plants to the light,—the formation of crystals,—the knowledge that birds and quadrupeds seem to possess of the cardinal points, as probably arising from the sensibility of their hairs and feathers to the impressions of light, electricity, and magnetism, and through them to the nervous system and sensorium. As farther explanatory of the polarity of the needle, if any current of magnetism is allowed to exist, and of the diurnal variation of the pointing and dip, as dependent on the motions of the sun: And from the principle that light attracts bodies or the parts of bodies that have been in the shade, and repels that which has been for some time exposed to its influence, producing by this means a continual revolution in bodies of a spheroidal form; it is thought probable that this may be one cause of the diurnal rotation of the earth and the planets.

It has not been observed that any of these bodies indicate the electrical changes of the atmosphere; because the changes in respect to them must be general, or affecting each part of them equally. The silver-leaf, indeed, has sometimes a curious vibratory motion; but these vibrations are evidently regulated by any beam of light falling on the disc. Two of the discs suspended on two pivots, and opposed to each other, would no doubt act as an electroscope.

On the History and Constitution of Benefit or Friendly Societies. By Mr William Fraser. (Concluded from former Number, p. 313.)

Since the publication of the former number of this Journal, Mr Courtenay has brought into Parliament the bill which we then alluded to, for consolidating and amending the laws relative to Friendly Societies. The benefits offered to these societies in England, by this statute, are (except the power of settling disputes by arbitration, which is to be repealed) nearly the same as those which they formerly enjoyed; namely, that their money may be paid into the Bank of England, to account of the officers of the National Debt Office, at a certain high rate of interest,—that both principal and interest shall always be at the command of the office-bearers of the societies,—that they may sue and be sued, and their property invested, in the name of their office-bearers, in the same way as is done by incorporated bodies,—and that no bond or other security given to or on account of any society, shall be chargeable with stamp-duty. It is further proposed, that all former acts regarding these institutions shall be repealed,—that before any new society, or any old one requiring alterations in its rules, shall be hereafter entitled to the benefits of this act, its regulations and tables must have been submitted to, and approved of by, the officers of the National Debt Office, and the Quarter Sessions of the Justices of the Peace of the county wherein the society is situate, or intended to be established,—that persons, assessed to a certain extent for the relief of the poor, must be nominated trustees, in whom all the society's property shall be vested, who shall not be removeable, nor obliged to find security for their intromissions, without their own consent, and who shall have the sole appointment of the treasurer,—that societies shall periodically transmit to the National Debt Office, through the clerks of the Peace, returns of their accounts and affairs,—that no alterations on the rules or tables of any society shall be lawful without the consent of the trustees and approval of the Justices,—that the Quarter Sessions shall have liberty to make such alterations as they may think proper,—and that the Justices in Petty Sessions shall alone be competent to decide every question that may arise between societies and their members, without the power of any appeal whatever.

These extraordinary enactments have been thought necessary, not only to secure contributions adequate to the promised benefits, but also to put an end to the pernicious system of management which at present obtains among Friendly Societies in England. The meetings there are commonly held in public houses, the publicans are in general the treasurers, peculation to a great extent is said to prevail, and the members are laid under the necessity of spending a large sum annually at the monthly and anniversary meetings.

This is very different from the manner in which Friendly Societies in Scotland are conducted. The most rigid economy, and, in general, fidelity exist in their management; the services of all the office-bearers, with the exception of the clerk, have been hitherto entirely gratuitous; and their meetings are held in school-rooms, or other similar places, quite unconnected with public-houses. It may be therefore safely said, that not mismanagement, but miscalculation, has been the cause of failure with Friendly Societies in Scotland; and it is gratifying to be also able to state, that active measures are now every where taking to rectify this important defect, and place societies upon the most secure basis. Owing to these circumstances, it is believed, the proposed bill was not intended to apply to Scotland.

So long, however, as the above pernicious mode of management prevails among societies in England, it is naturally concluded, that any rules or tables, however accurately framed at first, will be ultimately rendered of no avail; and it has therefore been conceived that an end should be put to this system by the Legislature itself. But societies, on the other hand, consider such interference as an infringement of the rights of individuals to manage their own affairs, and as totally subversive of the independence of their institutions. The clauses requiring the appointment of irresponsible and irremoveable trustees, depriving the members of the right to appoint their own treasurers, and annulling the power to settle disputes by arbitration, granted by former statutes, have proved particularly obnoxious;—and the consequences have been, that very general dissatisfaction and alarm have been excited throughout England; petitions against the bill have been poured into Parliament from every quarter, and it has been ultimately found necessary, not only considerably to modify it, but even to delay any farther proceedings during the present session.

It cannot be denied, that the objects proposed to be attained by this statute are highly laudable, and that some measures should be taken to remedy the evils complained of; but it is to be regretted, that the means which have at present been resolved on, are perhaps among the most objectionable which could have been devised. No body of men, associated for harmless and useful purposes, however insignificant these purposes might be, would submit to be imperatively dictated to, and to be placed under the entire controul of the inferior magistracy, with regard to the management of their own funds and concerns. It is not therefore surprising, that Friendly Societies, which comprise so great a part of the population, and whose objects are not only highly beneficial to themselves, but also to the whole community, should oppose such an attempt against their rights, and claim a continuance of those privileges which they have so long enjoyed.

The only way, it is conceived, in which Friendly Societies may be speedily and effectually improved, is by instruction and advice; and these, too, given in a conciliatory, not in a compulsory manner. Proper tables and fundamental rules, with explanatory remarks, could easily be kept at all the offices of the Clerks to the Peace, and exhibited to such societies as might at any time present their regulations for enrolment. Many would no doubt refuse at first to adopt them, but then such refusal could be stated in the certificates of enrolment, and the members thus be made aware of the insecurity of their schemes. Doubts and anxiety would be thereby created in their minds, the subject would be investigated, they would soon become convinced of their errors, and new societies would be immediately instituted upon improved principles, and under proper management. Society members would soon perceive it to be their interest to join these new institutions in preference to the old ones, notwithstanding every influence that publicans and others, interested in their schemes, might possess; and the supply of entrants being thus cut off from them, they would very speedily all cease to exist.

The success of such simple but effectual measures has been already completely exemplified in Scotland. As soon as the Highland Society of Scotland published their Report on Friendly Societies in 1824, copies were sent to the head magistrates of burghs, to the convener of each county, for the use of the clerk of the Peace, and to all the persons who had sent in Returns, with a request to the magistrates and conveners, that the contents might be made known to any societies in the vicinity. By these means, a spirit of inquiry was soon excited, societies became convinced of the erroneous principles on which they had been instituted, new societies immediately began to be founded upon more secure bases, these are now rapidly increasing, and, although their contributions are higher, they are universally preferred to the old institutions, whose schemes it has generally been found impracticable to improve. Let these or similar means be resorted to in England, and the same effects will undoubtedly follow.

We formerly gave a brief detail of the investigations into the rate of mortality among mankind, and endeavoured to shew, from various sources, that the Northampton tables are unfit for the practical purposes of health and life assurance. This has been since completely put beyond doubt, by Mr John Finlaison, actuary to the National Debt Office, who has shewn, to the satisfaction of Government, that the country has for some time been losing about L. 6000 a-week, or upwards of L. 300,000 annually, by the state annuitants, in consequence of the value of their lives having been calculated by these tables. A bill has therefore been brought into Parliament this session, and passed, for repealing the statute by which such annuities were granted, and which annuities must still, for a long time, remain a heavy burden on the country. It is now evident, as was formerly remarked, that the premiums calculated by the Northampton tables, and demanded by life assurance companies, for sums payable at death, must have been very much in excess, since those for annuities were so far deficient; and hence the propriety of the lower rate of mortality adopted by the Highland Society of Scotland in calculating tables for Friendly Societies. Having already given some of these tables, we shall now proceed to illustrate more fully the principles upon which they were framed, and the mode of using them, for the purpose of investigating the state of societies' affairs.

As before frequently observed, it is essential to the permanence of every society, that there should be calculated at the commencement, the amount of contribution which will be required to defray the contemplated benefits, so that all the members, the last as well as the first, shall be insured of allowances corresponding to their payments, and to their ages at entry. At first sight such a calculation may appear very difficult, if not altogether impracticable, owing to a Friendly Society being a body consisting of all ages, varying in numbers from time to time, and the demands for sickness and death also varying in proportion to the number and ages of the members. But, to simplify the process, instead of viewing a society some time after its commencement, let one be supposed to have just commenced, and to be composed of individuals either of the same or of various ages, who are to contribute certain sums annually on the one hand, and to receive certain allowances on the other, till a higher age, or till all are dead. Were the progress of such a society to be traced, and a distinct account kept of the contributions and allowances of the original members till all had died; and were it found, that all they had paid in during life, with accruing interest, was equivalent to the whole they had drawn out, also with interest, it might be inferred, that, so far as these persons were concerned, their contributions and allowances had been properly adapted to each other. Were the progress of a second, a third, and a fourth body of members to be noted, and the same results obtained, it might then be safely concluded, that that society was established upon secure principles. There would thus be ascertained, 1*st*, the total amount of contributions; 2*d*, the rate or number of weeks' sickness which had occurred at each age, and for which allowances had been paid; 3*d*, the number of deaths, the ages at which they had occurred, and the disbursements on their account; 4*th*, the interest which had been received for the capital; 5*th*, the interest which had been lost on the allowances; and, *lastly*, the total amount of the expenditure.

Again, were a number of societies to be conducted in the same way, and their whole results found to lead, although not exactly, to the same general conclusions, an average of the whole could be taken, and such an average might with safety be adopted as a standard for the guidance of societies in future. It may be observed, that it would not be even necessary for all these societies to have had the same rates of contributions and benefits. The only things requisite to be ascertained, would be the number of weeks' sickness, and the number of deaths that had happened at each age or class of ages; for these being known, any given contribution could be accurately calculated for any specified allowance.

Now, although Friendly Societies, so far as is known, have never kept any such records of their transactions as are here alluded to, yet the results of the late investigation of the Highland Society have served the same purpose, at least for ascertaining the rate of sickness. The return of the 73 societies reported, shew how many weeks of sickness occurred among the free members of each society in every decade or period of ten years, from about twenty to upwards of seventy years of age; and taking the average sickness of each decade (which we gave in a former number), and assuming the allowance to be L.1 per week, the total expenditure to the sick would be the same as if each free member had been entitled to a yearly allowance or

	Life Annuity of	Which was to cease at the age of
Commencing at any age at which he had entered the society under 20	£0.379735*	20
And in lieu thereof, when he came to be 20, (or if he had entered the society at any age above 20, and under 30)	0.591569	30
And in lieu of this last, when he came to be 30, (or if he had entered the society at any age above 30 and under 40)	0.686523	40
And again, in lieu of this last, when he came to be 40, (or if he had entered the society at any age above 50 and under 60)	1.880576	60
And again, in lieu of this last, when he came to be 60, (or if he had entered the society at any age above 60 and under 70)	5.633684	70
And, lastly, in lieu of the latter, when he came to be 70	16.541704	For the rest of life.

Such is the view of the value of the annual sick allowances, or rather of a contingent annuity, according to the rate of sickness in each decade, as reported to the Highland Society of Scotland, given by Mr Finlaison in his Report to the Select Committee of the House of Commons on Friendly Societies in 1825; and he has also given various rules and tables for ascertaining the requisite contributions from members entering at any age to defray these allowances, similar to those given previously in the appendix to the Highland Society's Report. But as space will not admit of entering here into that process of calculation, and as, at any rate, it would not perhaps be easily understood by the class of readers for which these observations are intended, the method adopted in the body of the Report of the Committee of the Highland Society, which was considered simpler than that in the appendix, shall alone be adverted to.

The rate of sickness being found in the way already mentioned, and the rate of mortality from an average of the Northampton, Swedish, and Carlisle tables, it was calculated what L.1 of annual contributions for fifty years from members entering a society at 21 years of age, would amount to with interest, when the survivors arrived at the age of 70, and also at the death of the last member; and likewise what L. 1 of weekly sick allowance paid to each of these members during sickness, would amount to with interest at 70; also, what an allowance of L. 1 for each death would amount to with interest, at the death of the last member. From comparing these, it was found, 1st, that if each member were to pay an annual contribution of L. 1, from commencing his 21st till concluding his 70th year of age, should he live so long, and then to cease contributing, such annual contribution would afford a weekly allowance during sickness from 21 to 70, of L. 1 : 0 : 7; 2d, that a like contribution would afford to each surviving member, during life, after his 70th year, a life annuity or permanent annual allowance of L. 58 : 0 : 2¼ Sterling; and, 3d, that a like annual contribution would afford a sum payable at the death of each member of L. 59 : 19 : 2.

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* This article being chiefly intended for those who may not be familiar with decimals, it has been thought proper to give the following rule:—

"To convert decimals into shillings and pence, double the first decimal on the right of the point for shillings, adding 1 if the 2d decimal be 5 or above it. Consider the 2d and 3d decimals (deducting 50 if 1 was added to the shillings), as farthings, diminishing this number by 1 if it be above 12, and less than 37, and by 2 if it be above 36. The 4th decimal may be neglected."—*High. Soc. Report*, p. 196, 197.

In order to illustrate these calculations, and to exhibit, in the simplest form, a view of the course of affairs in a Friendly Society, it was resolved to "adopt the supposition of a society of persons entering in the 21st year of their age, and continuing united till all the members may be supposed to be dead, the society to commence with 1005 persons, and to admit no future entrants. In tracing the progress of this society year by year, till all its members, according to the table of mortality, may be supposed to be dead, there is seen the accumulation of its stock for a long period, then its diminution, and at the death of the last member, its final extinction. Hence the means are given to draw conclusions applicable to all Friendly Societies at whatever age entrants are admitted; for the same terms of contribution and allowance calculated for a society which admits no new members, are applicable to a society which is continually recruited by new members of the age for which the calculations are made, or to a society admitting members at later ages, upon payment of a proper fine or regulating payment. *" With a view, also, to accommodate the payments to the circumstances of every individual, the contributions were contemplated under three different aspects: "1st, as paid and accumulated annually; 2d, as superseded by a single payment made at the commencement of the scheme, in lieu of all annual contributions; and, 3d, as superseded at any later age, between 20 and 70, by a single payment then made in lieu of all contribution after such later age. †" As explanatory of these calculations, numerous tables and rules are given for all the four schemes, and from which there may likewise be deduced, by the ordinary rules of Proportion or Rule of Three, the necessary contributions for any other allowances than those therein assumed. As the tabular form, however, will illustrate to ordinary readers the operations of a Friendly Society more distinctly than any brief set of rules which could here be given, we have compiled the following table from those of the Sickness Scheme given in the Report.

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* Report, p. 46. † Report, p. 62.

TABULAR VIEW of the Commencement, Progress, and Termination of a
and Allowances for Sickness from 21 *to* 71 *years of age, when the Sickness*

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Year of Society.	Age.	Number alive.	Annual Contribution.	Total Contributions without Interest.	Interest at 4 per cent.	Amount with Interest.	Weeks of Sickness.	Annual Distribution.	Total Distributions without Interest.
1	21	1000	£1000				575.000	£592.092	
2	22	990	990	£1000.000	£40.000	£1040.000	570.240	587.190	£592.092
3	23	980	980	2030.000	81.200	2111.200	566.440	583.277	1202.966
4	24	970	970	3091.200	123.648	3214.848	563.570	580.322	1834.361
5	25	960	960	4184.848	167.394	4352.242	561.600	578.294	2488.958
6	26	950	950	5312.242	212.490	5524.732	560.500	577.161	3165.874
7	27	940	940	6474.732	258.989	6733.721	560.240	576.893	3869.670
8	28	930	930	7673.721	306.949	7980.670	560.790	577.460	4601.850
9	29	920	920	8910.670	356 426	9267.096	562.120	578.829	5362.864
10	30	910	910	10187.096	407.484	10594.580	565.110	581.908	6156.207
11	31	900	900	11504.580	460.183	11964.763	567.900	584.781	6984.363
12	32	890	890	12864.763	514.591	13379.354	570.490	587.448	7848.519
13	33	879	879	14269.354	570.774	14840.128	573.108	590.144	8749.908
14	34	868	868	15719.128	628.765	16347.893	575.484	592.590	9690.048
15	35	857	657	17215.893	688.636	17904.529	578.475	595.670	10670.240
16	36	846	846	18761.529	750.461	19511.990	582.048	599.349	11692.720
17	37	835	835	20357.990	814.320	21172.310	586.170	603.594	12759.778
18	38	824	824	22007.310	880.292	22887.602	591.632	609.218	13873.763
19	39	812	812	23711.602	948.464	24660.066	598.444	616.233	15087.931
20	40	800	800	25472.066	1018.883	26490.949	606.400	624.425	16255.681
21	41	788	788	27290.949	1091.638	28382.587	617.792	636.156	17530.334
22	42	776	776	29170.587	1166.823	30337.410	631.664	650.440	18867.703
23	43	764	764	31113.410	1244.537	32357.947	650.928	670.277	20272.851
24	44	752	752	33121.947	1324.878	34446.825	678.304	698.467	21754.042
25	45	740	740	35198.825	1407.953	36606.778	711.880	733.041	23322.671
26	46	727	727	37346.778	1493.871	38840.649	750.264	772.560	24988.619
27	47	714	714	39567.649	1582.706	41150.355	791.112	814.620	26760.780
28	48	701	701	41864.355	1674.574	43538.929	831.386	856.099	28645.787
29	49	688	688	44239.929	1769.597	46009.526	875.136	901.150	30647.717
30	50	675	675	46697.526	1867.901	48565.427	918.675	945.983	32774.776
31	51	661	661	49240.427	1969.617	51210.044	959.111	987.621	35031.750
32	52	647	647	51871.044	2074.842	53945.886	997.027	1026.664	37420.641
33	53	633	633	54592.886	2183.715	56776.601	1033.689	1064.416	39944.131
34	54	619	619	57409.601	2296.384	59705.985	1068.394	1100.153	42606.312
35	55	605	605	60324.985	2413.000	62737.985	1101.705	1134.454	45410.717
36	56	590	590	63342.985	2533.719	65876.704	1131.620	1165.257	48361.600
37	57	575	575	66466.704	2658.668	69125.372	1160.350	1194.842	51461.821
38	58	560	560	69700.372	2788.015	72488.387	1188.320	1223.644	54744.616
39	59	544	544	73048.387	2921.936	75970.323	1213.120	1249.181	58126.844
40	60	528	528	76514.323	3060.573	79574.896	1238.688	1275.508	61701.099
41	61	512	512	80102.896	3204.116	83307.012	1280.000	1318.048	65444.651
42	62	496	496	83819.012	3352.760	87171.772	1357.056	1397.395	69380.485
43	63	479	479	87667.772	3506.711	91174.483	1484.900	1529.039	73553.100
44	64	461	461	91653.483	3666.139	95319.622	1705.700	1756.403	78024.263
45	65	443	443	95780.622	3831.225	99611.847	1949.200	2007.141	82901.636
46	66	423	423	100054.847	4002.194	104057.041	2284.200	2352.099	88224.842
47	67	403	403	104480.041	4179.202	108659.243	2659.800	2738.864	94105.935
48	68	381	381	109062.243	4362.490	113424.733	3009.900	3099.371	100609.037
49	69	359	359	113805.733	4552.229	118357.962	3338.700	3437.945	107732.769
50	70	336	336	118716.962	4748.678	123465.640	3595.536	3702.414	115480.025
51	71	313		123801.640	4952.066	128753.706			123801.640

Friendly Society upon proper principles, so far as regards the Contributions Scheme is supposed to terminate.

11.	12.	13.	14.	15.	16.	17.	18.	
Interest at 4 per cent.	Amount with Interest.	Balance or Nett Stock of Society.	Individual Stock.	Value of Future Contributions.	Value of Future Distributions.	Increase of Annual Contribution.	Diminution of Annual Distribution.	Age.
				£18.1173	£18.1173	£1.00000	£1.029725	21
£23.684	£615.776	£424.224	£ .4285	17.9818	18.4103	1.02383	1.005758	22
48.118	1251.084	860.116	.8777	17.8413	18.7190	1.04919	.981443	23
73.375	1907.736	1307.112	1.3475	17.6955	19.0430	1.07615	.956860	24
99.522	2587.580	1764.662	1.8882	17.5442	19.3824	1.10477	.932067	25
126.635	3292.509	2232.223	2.3497	17.3871	19.7368	1.13514	.907135	26
154.787	4024.457	2709.264	2.8822	17.2238	20.1060	1.16734	.882114	27
184.054	4785.404	3195.266	3.4357	17.0542	20.4899	1.20146	.857063	28
214.514	5577.378	3689.718	4.0106	16.8779	20 8885	1.23762	.832017	29
246.248	6402.455	4192.125	4.6067	16.6944	21.3011	1.27594	.807031	30
279.375	7263.738	4701.025	5.2234	16.5036	21.7270	1.31650	.782168	31
313.941	8162.460	5216.894	5.8617	16.3049	22.1666	1.35950	.757426	32
349.996	9099.904	5740.224	6.5304	16.1163	22.6467	1.40520	.732794	33
387.602	10077.650	6270.243	7.2238	15.9202	23.1440	1.45375	.708323	34
426.810	11097.050	6807.479	7.9433	15.7161	23.6594	1.50542	.684010	35
467.709	12160.429	7351.561	8.6898	15.5037	24.1935	1.56050	.659869	36
510.391	13270.169	7902.141	9.4636	15.2826	24.7462	1.61924	.635931	37
554.950	14428.713	8458.889	10.2656	15.0522	25.3178	1.68200	.612203	38
601.517	15639.448	9020.618	11.1091	14.8303	25.9394	1.74908	.588723	39
650.228	16905.909	9585.040	11.9813	14.5993	26.5806	1.82068	.565573	40
701.213	18231.547	10151.040	12.8820	14.3586	27.2406	1.89709	.542771	41
754.708	19622.411	10714.999	13.8080	14.1078	27.9158	1.97875	.520392	42
810.914	21083.765	11274.182	14.7568	13.8462	28.6030	2.06576	.498471	43
870.162	22624.204	11822.621	15.7216	13.5733	29.2949	2.15827	.477106	44
932.907	24255.578	12351.200	16.6908	13.2882	29.9790	2.25606	.456426	45
999.545	25988.164	12852.485	17.6788	13.0083	30.6871	2.35904	.436502	46
1070.429	27831.159	13319.196	18.6543	12.7160	31.3703	2.46699	.417401	47
1145.831	29791.618	13747.311	19.6110	12.4106	32.0216	2.58018	.399090	48
1225.909	31873.626	14135.900	20.5464	12.0913	32.6377	2.69927	.381482	49
1310.991	34085.767	14479.660	21.4513	11.7571	33.2084	2.82454	.364564	50
1401.270	36433.020	14777.024	22.3556	11.4243	33.7799	2.95685	.348251	51
1496.826	38917.467	15028.419	23.2279	11.0759	34.3038	3.09716	.332474	52
1597.765	41541.896	15234.705	24.0675	10.7107	34.7782	3.24705	.317126	53
1704.252	44310.564	15395.421	24.8714	10.3275	35.1989	3.40827	.302125	54
1816.429	47227.146	15510.839	25.6378	9.9251	35.5629	3.58313	.287382	55
1934.464	50296.064	15580.640	26.4079	9.5180	35.9259	3.77452	.272809	56
2058.453	53519.774	15605.598	27.1401	9.0809	36.2300	3.98574	.258352	57
2188.584	56903.200	15585.187	27.8307	8.6388	36.4695	4.22159	.243918	58
2325.074	60451.918	15518.405	28.5265	8.1781	36.7046	4.48816	.229432	59
2468.044	64169.143	15405.753	29.1775	7.6914	36.8689	4.79352	.214816	60
2617.786	68062.437	15244.575	29.7746	7.1765	36.9511	5.14890	.199989	61
2775.220	72155.705	15016.067	30.2743	6.6308	36.9051	5.56571	.185012	62
2942.124	76495.224	14679.259	30.6456	6.0639	36.7095	6.05378	.170096	63
3120.970	81145.233	14174.389	30.7470	5.4720	36.2190	6.61897	.155572	64
3316.065	86217.701	13394.146	30.2351	4.8399	35.0750	7.24705	.142089	65
3528.994	91753.836	12303.205	29.0856	4.1823	33.2679	7.95445	.129453	66
3764.238	97870.173	10789.070	26.7719	3.4739	30.2458	8.70658	.118270	67
4024.361	104633.398	8791.835	23.0743	2.7214	25.7957	9 47883	.108634	68
4309.311	112042.080	6315.882	17.5930	1.8999	19.4929	10.25995	.100363	69
4619.201	120099.226	3366.414	10.0191	1.0000	11.0191	11.01910	.093449	70
4952.066	128753.706							71

By this table it will be perceived, that, with the advance of age, the members (column 3.) are every year diminishing by death, and the sickness (col. 8.) is every year increasing *; hence, while the annual income (col. 4.) decreases, the expenditure (col. 9.) increases. It will be likewise perceived, however, that when 4 per cent. interest (col. 6.) is added to the contributions (col. 5.), and also 4 per cent interest (col. 11.) to the distributions (col. 10.), and when the total amount of the two latter (col. 12.) is deducted from the amount of the two former (col. 7.), a large balance (cols. 13. and 14.) will for many years be left in favour of the surviving members;—that this balance will accumulate at first very rapidly, but afterwards more slowly until the age of 64, when it will begin to decrease;—that at the age of 71 (in the middle of which year of age, both contributions and allowances for sickness were calculated to cease), it will be wholly exhausted;—and that then both the amount (col. 7.) of the contribution with interest, and the amount (col. 11.) of the distribution, with interest, will be found exactly to equal each other.

This society, it has been stated, is supposed to have begun with 1006 members, all at the commencement of their 21st year of age, or rather, owing to the contributions and allowances being considered as payable at various times in the year, with 1000 members, being the average number alive in the *middle* of that year of age, and to have admitted no new entrants from its commencement till its termination;—circumstances, however, which are not likely ever to occur in actual practice, and the conclusions may therefore perhaps at first sight appear to be inapplicable to the operations of real societies. This large number of members was assumed for the sake of avoiding the awkward and unnatural appearance of fractional parts in the annual mortality, which would necessarily have resulted, had a smaller number been taken; and, with regard to no new members being supposed to be admitted, it will be obvious that it matters not whether the original entrants had remained the sole members, or new ones been admitted at all ages, provided each new member of a higher age than 21, had paid—either a sum equal to the stock which the original members had in the society, after defraying all their allowances, when they arrived at his age,—or a single or increased annual contribution that would ultimately amount to it,—or should have only been entitled to a lower rate of allowance than the earlier entrant, making the same payment.

For example, the standard annual contribution of the original members being L. 1, and the weekly sick allowance L. 1 : 0 : 7, when the society has been ten years in existence, and these members have reached the middle of their 31st year of age, they would then have a total capital of L. 4701.026 (Table, col. 13.) or L. 5.2234 each (col. 14.), and this sum, it has been shewn, would, along with their future contributions, be all required to defray their future allowances. Now, as a member just entering at that age, has, with a very slight difference (owing to his being then in health which some of the first members may not now be), the same chances of sickness and death in time to come, with the original entrants still alive,—and as his future contributions are of less value (col. 15.) while his future distributions are of more value

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* By this column, the aggregate amount of sickness appears to be every year diminishing, from the 21st to the 28th year of age, but although this is the case with regard to the society as a body, it will be found, upon dividing the sickness by the number of members alive each year, not to be applicable to them as individuals:—See the table of the Law of Sickness, with reference to an individual, given in the Number of this Journal for July 1827.

(col. 16.) to the society than they would have been at 21,—it is evident, that, to receive equal benefit with those members who entered at that age, he should either pay upon entry an equalizing sum of L. 5.2234 (col. 14.), which each of the others has already accumulated, and the standard yearly contribution of L. 1 afterwards,—or an increased annual contribution of L. 1.31650 (col. 17.),—or receive a reduced allowance of only L. 0.782168 (col. 18.)

As formerly remarked, it was resolved by the Committee of the Highland Society, from the returns affording no proper data for calculating, with any degree of accuracy, the rate of sickness above 70, to terminate the sickness scheme at that age, and to provide for an annuity to such members as should survive it. By column 3. it will be perceived, that, according to the rate of mortality adopted, no less than 313 of the original 1000 members would still remain alive at the age of 71, and who consequently would be left unprovided for in old age and infirmity, had they not also contributed to the annuity scheme. This is wished to be particularly remarked, as very considerable difficulty has been experienced in attempting to convince society members of the necessity of contributing for an annuity, to commence even at the earlier ages of 60 or 65,—at the former of which ages there would be alive out of the 1000 who commenced contributing at 21 no less than 528, and at the latter age 442. This reluctance to contribute for an annuity, arises from its being supposed that few, if any, of the working classes will survive these advanced ages; but, in refutation of this erroneous idea, and in confirmation of the accuracy of the table, we need only refer to the great number of old pensioners from the army and navy, notwithstanding the innumerable dangers of sea and war; and of others, both males and females, who annually become inmates and out-pensioners of the work-houses and other public charities.

Having thus endeavoured to exhibit the operations of the Sickness Scheme, we might next proceed to trace in the same manner those of the Annuity and Funeral Schemes, but as this would be tedious, and perhaps also unnecessary, the contributions for each of these benefits being the same as the one for sickness, there shall be merely shewn the progress of the total and individual capital of each of these funds.

It may be premised, that the number of members stated to be annually alive in the Annuity and Funeral Schemes, is somewhat different from that given in the Sickness Scheme. This arises from the number alive in the latter scheme being taken in the middle of the year, as was done by the Committee of the Highland Society for all the schemes; while here, the number alive in the Annuity and Funeral Schemes is calculated for the beginning of each year, after the 21st year of age. This has been done, with regard to the funeral allowance, to avoid the discrepancy alluded to in the note at p. 258. of the Report of the Highland Society, where it is said, "that the difference betwixt the result by the common mode of calculation, and the one adopted in the Report, is owing to the manner in which the average number of living throughout the year is taken, by which it happens that the number of deaths is not always the exact difference between the successive numbers of the living." The effect of this is to make the individual values less in the earlier ages, and greater in the higher ones. The following Tables, with these divisors, were found among the papers of the late Mr Skirving, accountant, which have been kindly communicated to us by his widow.

TABLE shewing the Annual Accumulation or Value of the Total and Individual Stock in the Annuity and Funeral Schemes from 21 *to* 95 *years of age, arising from a Yearly Contribution to each Scheme of* £1 *from* 21 *to* 71 *years of age, when the Contributions cease.*

		ANNUITY.		FUNERAL.				ANNUITY.		FUNERAL.	
1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.
Age.	Number alive.	Stock of the Society each year.	Stock of each Member yearly.	Stock of the Society each year.	Stock of each Member yearly.	Age.	Number alive.	Stock of the Society each year.	Stock of each Member yearly.	Stock of the Society each year.	Stock of each Member yearly.
21	1005	£ dec.	£ dec.	£ dec.	£ dec.			£ dec.	£ dec.	£ dec.	£ dec.
22	995	1040.000	1.045	416.433	.418	59	552	75970.323	137.627	15589.137	28.241
23	985	2111.200	2.143	839.123	.852	60	536	79574.896	148.461	15780.754	29.442
24	975	3214.848	3.297	1268.319	1.301	61	520	83307.012	160.206	15963.396	30.699
25	965	4352.242	4.510	1704.285	1.766	62	504	87171.772	172.959	16136.708	32.017
26	955	5524.732	5.785	2147.289	2.248	63	487	91174,483	187.216	16237.947	33.343
27	945	6733.721	7.126	2597.613	2.749	64	470	95319.622	202.808	16335.560	34.735
28	935	7980.670	8.535	3055.549	3.268	65	452	99611.847	220.380	16335.600	36.141
29	925	9267.096	10.018	3521.403	3.807	66	433	104057.041	240.316	16264.966	37.563
30	915	10594.580	11.579	3995.492	4.366	67	413	108659.243	263.097	16108.350	39.003
31	905	11964.763	13.221	4478.144	4.948	68	392	113424.733	289.349	15862.312	40.465
32	895	13379.354	14.949	4969.703	5.553	69	370	118357.962	319.886	15521.196	41.949
33	884	14840.128	16.787	5408.166	6.118	70	347	123465.640	355.809	15081.198	43.462
34	873	16347.893	18.726	5852.728	6.704	71	324	128753.706	397.388	14599.681	45.061
35	862	17904.529	20.771	6303.634	7.313	72	301	115020 128	382.127	13749.462	45.679
36	851	19511.990	22.928	6761.134	7.945	73	278	102124.829	367.392	12865.235	46.278
37	840	21172.310	25.205	7225.496	8.602	74	256	90101.341	351.958	12007.996	46.906
38	829	22887.602	27.609	7696.991	9.285	75	234	78924.203	337.283	11116.467	47.506
39	818	24660.066	30.147	8175.906	9.995	76	213	68566.939	321.910	10251.634	48.129
40	806	26490.949	32.867	8599.142	10.669	77	192	59062 344	307.611	9352.207	48.709
41	794	28382.587	35.746	9026.826	11.369	78	172	50444.523	293.282	8479.160	49.297
42	782	30337.410	38.795	9459.138	12.096	79	153	42628.288	278.616	7633.549	49.892
43	770	32357.947	42.023	9896.263	12.852	80	135	35645.698	264.042	6816.468	50.492
44	758	34446.825	45.444	10338.392	13.639	81	118	29409.439	249.232	6029.068	51.094
45	746	36606 778	49.071	10785.727	14.459	82	102	23949.364	234.798	5272.517	51.691
46	733	38840.649	52.997	11176.118	15.247	83	87	19175.856	220.412	4548.067	52.277
47	720	41150.355	57.153	11568.605	16.068	84	73	15116.379	207.074	3856.995	52.836
48	707	43538.929	61.582	11963.271	16.921	85	60	11678.830	194.647	3200.637	53.344
49	694	46009.526	66.296	12360.204	17.810	86	49	8827.758	180.158	2642.738	53.933
50	681	48565.427	71.315	12759.494	18.736	87	39	6526.287	167.341	2124.880	54.399
51	668	51210.044	76.662	13161.236	19.702	88	30	4675.739	155.858	1648.664	54.955
52	654	53945.886	82.486	13502.131	20.646	89	23	3233.821	140.601	1278.113	55.570
53	640	56776.601	88.713	13842.101	21.628	90	17	2156.546	126.850	955.097	56.182
54	626	59705.985	95.377	14181.110	22.653	91	12	1337.837	111.489	681.518	56.793
55	612	62737.985	102.513	14519.121	23.724	92	8	788.036	98.504	459.351	57.419
56	597	65876.704	110.346	14793.734	24.780	93	5	397.238	79.447	290.655	58.131
57	582	69125.372	118.772	15063.732	25.883	94	3	171.801	57.267	177.568	59.189
58	567	72388.387	127.669	15328.930	27.035	95	1	58.011	58.011	59.958	59.958

It may be mentioned, that the rapid accumulation of total and individual capital which takes place in the Annuity Scheme, not only arises from the annual addition of interest upon the capital, but also from the surviving members acquiring right to both the contributions and accruing interest of those who have died. The accumulation of capital in the Sickness Scheme is also owing, in a certain degree, to the same cause; but in the Funeral Scheme, the fund is diminished to the survivors by those who die in early life. The payments for this allowance are calculated more directly than the others, upon the probability of a person at any given age living to a certain higher age, or upon the number of years which, taking lives of the same age, one with another, any one of those lives may be considered as sure of enjoying,—those who live beyond that period enjoying as much more, in proportion to their number, as those who fall short of it enjoy less." It will therefore be obvious, that, as no disbursement is made from the Annuity Scheme till each surviving member reaches the 71st year of his age, the capital of this fund must accumulate very rapidly for a number of years after the commencement of the society, and that the survivors must be very great gainers by every death which has previously taken place. On the other hand, it will likewise be obvious, that, as the disbursements of the Funeral Scheme are calculated to commence with the very institution of the society, the capital of that fund must accumulate much more slowly, and that a loss will be sustained to the society by those who die early, which must be again compensated by those who live to old age. Hence it follows, that, in the Annuity Scheme, those who die soon are great losers, and those who live long are as much gainers; while in the Funeral Scheme, on the contrary, the representatives of those who die early are gainers, and those who live long are losers,—the younger class in this scheme receiving more than they pay, and the older class paying more than they receive.

Such being the nature of the operations of these two schemes, and to a certain degree also of that for sickness, it would be of great advantage, both to the members individually and to the society as a body, that, alongst with any benefit during sickness or at death, there should likewise be assured an annuity in old age. In this way the members who should be favoured with long health and life, and consequently be losers by the sickness and funeral schemes, would be as great gainers by the annuity scheme; and the society would also be in a great measure protected against the admission of bad lives and premature allowances during sickness and at death, as none such would choose to pay for an annuity which there was no probability of their ever enjoying. This combination of benefits, too, would greatly tend to diminish that species of imposition so frequently practised upon societies, of understating ages at entry, and which there is frequently no possibility of detecting; for few insuring for an annuity would understate their ages for the purpose of at first saving a trifle on their annual contributions, while they would ultimately run the risk of loss by their annuity being so much longer deferred. Laying, therefore, entirely out of view the necessity for providing for old age, it will be seen that it is only by having an annuity combined with the other benefits that a society will be safe from imposition, and that the members themselves will be *insured* of an adequate return for their contributions to the sickness and funeral schemes.

It is trusted that enough has now been stated to convince the members of Friendly Societies that the rates of both sickness and mortality are much less in the earlier than in the more advanced periods of life, and that the contributions at the commencement must therefore be either greatly more than is necessary at first to defray the allowances, or that the former must be increased, or the latter reduced, as the members advance in age. Let it be particularly remembered, that, if a society's weekly sick allowance were the same sum as the annual contribution, the amount that would be annually required by all the sick members between 50 and 60 years of age, would be the same as if *each* member in the society between those ages were to receive nearly *double* the amount of his yearly contribution; from 60 to 70 it would be the same as if each were to receive somewhat more than *five* times the amount; and above 70 it would be the same as if each of the members of that class were to receive more than *sixteen* times the amount of his annual payment. This will shew the fallacy of the opinion always hitherto held, that as one member became old another young one would enter, and in this way the allowances to the former would be defrayed by the contributions of the latter. It will be seen from the above averages, that neither *five* nor *ten* members of the classes below 40 years of age, can support *one* member of each of the classes from 50 to above 70 years of age; for, as the average annual sickness of the whole members between 20 and 30 years of age is equal to 4 days 3 hours to each, and the average annual sickness of those between 30 and 40 years of age is equal to 4 days 19 hours to each, there can only remain a balance of the yearly contributions of each of the former class equal to 2 days 21 hours' sick-money, and a balance of the contributions of each of the latter class equal to 2 days 5 hours' sick money. How, then, can these small balances defray the sick allowances of one week, five weeks, and sixteen weeks, required by each of the members in the three classes above 50 years of age? It will thus be seen how societies who had accumulated little or no capital have gone so rapidly to ruin whenever they came to have a number of old members, and ceased to obtain young entrants. To ascertain what the accumulation should be, it is only necessary, with the *standard age at entry*, either to *fix the rate of contribution*, or *the rate of allowance*, which the society wishes to establish, and to calculate whether these will be equivalent to each other during the whole of life; the standard rate of sickness being taken, or any other rate which experience may have shewn to be applicable to their own circumstances. It will thus be known what balance of stock each member at every age should have in the society; and by calculating every three, five, or seven years, what the total of these balances should amount to, and comparing them with the society's actual funds in possession, it would always be accurately known how far the stock was keeping pace with the number and ages of the members. The importance and method of performing such an investigation we shall now attempt briefly to explain.

Balance of a Friendly Society's Affairs.

It is well known to be indispensably necessary that proper books should be kept by every individual or company carrying on business, for recording their transactions, and periodically ascertaining the state of their affairs. Without such books no degree of accuracy or chance of success can be expected by those embarked in even the most ordinary mercantile transactions, and as little, if not even less, by a company engaged in the traffic of life, sickness, and death. Such a company is a Friendly Society, and its business must be conducted on the same general principles as those of any other concern; that is to say, first, the true value of the commodities which are to be purchased and sold properly ascertained; next, the receipts and the debts due to the company compared with the expenditure and the debts due by the company; and then the profit or loss on the various transactions periodically ascertained. No person in business could obtain a proper knowledge of his affairs from merely knowing the money and goods he had at any time on hand, together with the debts that might be due to him, without also taking into account the stock with which he commenced, and the debts which he was still to be called upon to pay. Such, however, has been the method hitherto adopted by Friendly Societies—the receipt and expenditure of the *past* being merely compared with each other, and the balance in hand ascertained, but without any regard to the probable income and demands of the future. Hence it was impossible that societies could at any time know the real state of their affairs, with regard to the probable amount of the claims which were to come against them, or when they had too much or too little capital to meet them.

In order that Friendly Societies may be able to ascertain these particulars, it is necessary that the relations in which a society and its members stand to each other should be rightly understood, and that both should be fully aware of the interest which every individual has, or ought to have, at any time in the capital. For money received, societies undertake to pay sums afterwards to a greater amount; and therefore a society must always be debtor to the members, and they of course creditors, till the time and events arrive when the benefits become payable, and the members cease to have any farther interest in the society, or particular department to which they belonged. A Friendly Society consequently differs from every other company in this important respect, that it never can lose by bad debts of the members, the stock in hand being always of necessity more than the amount of any contributions which are ever allowed by the regulations to run in arrear. A society, however, may fall behind in its capital from other circumstances, such as more sickness and mortality occurring, and a lower rate of interest for money being obtained, than were originally calculated on; and hence it is necessary that proper books be kept, and periodical investigations made, to ascertain whether or not the stock be keeping up to the requisite amount.

In endeavouring to exhibit the nature of such an investigation, we shall merely take the Sickness Scheme as an example, in the first place, and again have recourse to the Table at p. 136; and we find that this Table cannot be better explained for the purpose in view, than by a statement, although written for a different purpose, by Mr Patrick Cockburn, accountant in Edinburgh. To his statement we shall merely add the columns of our table to which his remarks are applicable.

"It only remains to inquire *what is the stock of the society*, and what is *the interest* of each member in that stock at any given time. Now the stock of the society, at any given time, consists of two parts: *First*, Of the funds which have accumulated from the past contributions (col. 12.), after paying the claims which have emerged; and, *2dly*, Of the obligations of the members for their future contrbutions (col. 15. multiplied by the number of members in col. 3.) The former of these may be called 'The Fund in hand,' and the latter 'The Fund in expectation.' The fund in hand, added to the present value of the funds in expectation, calculated according to the tables, constitutes 'The Gross Fund or Stock of the Society.' Again, if we attend to the nature of the contract, it will appear evident that the value of each member's *interest in the fund* is measured by the *benefit for which he is assured*, modified by the different circumstances under which the benefit becomes payable; and it is easy to see, that the aggregate amount of the values of the individual interest of the members,—supposing there should be no deviation from the assumed laws (of sickness or) mortality, or rate of interest upon which the rates of contribution have been calculated,—will be always equivalent to the amount of the gross fund. The benefit assured to each individual is that according to which his contributions are made, and which he or his heirs or nominees will be entitled to claim as a debt upon the funds, whenever the event arrives upon which it becomes payable, or, in other words, it is his share of the stock which, upon his death or other contingency, is withdrawn from the concern.

"After the society has existed for any time, the share of stock held by each member, considered in relation to the mode of its being contributed, may be contemplated as consisting of two parts, viz. *first*, *His share of the fund in hand* (col. 14.), arising from his former contributions, which is equal to the present value of his benefit, *minus* the present value of his future contributions; and, *secondly*, *The value of his future contributions* (col. 15.) The sum of these two is evidently equal to the present value of his benefit assured (col. 16.) If it be said that, in estimating the value of the member's interests, his future contributions ought not to be taken into account, the answer is, that they are as effectually secured as any obligation in favour of the society, because the non-payment voids the policy; and, therefore, as well in respect to the individual as to the society, it is the same thing whether the stock consists of money paid down, and vested in securities granted by strangers, or in the obligations of the members. In short, the benefit assured, modified by the circumstances under which it is payable, may, to use a mercantile phrase, be considered as the amount due *to* the member upon his '*account in company*,' and his future contributions as the amount of what is due *by* him upon his '*account-current*.'

"Thus it follows, that *the interest* of every member in the *gross fund or stock of the society*, at any time, is equivalent to the *present value* of his benefit assured, or, in other words, it may be expressed by saying, that it is '*the benefit assured payable in the event or under the circumstances contained in the policy*[*].'"

If, therefore, a Friendly Society has proper tables, shewing the amount of capital which it should be possessed of for each member at every age, adequate with their future contributions to defray their future allowances, and if a proper record be kept of the number and ages of those insured for each benefit, it will be easy for such a society to ascertain the real amount of capital which it should at any time be possessed of. For example, let it be supposed that a society has existed for some length of time—that the calculations for the Sickness and Funeral Schemes have proceeded upon the same data as those of the Tables at p. 136. and 140,—that new members of various ages had been from time to time admitted, upon paying a fine or entry-money equal to the sum which members who entered at 21 had at their ages accumulated in the society, and that the present number and ages of the members is as stated in the following Table. It is required to know what stock the society should at present be in possession of, to be adequate, along with the future contributions, to defray the future allowances.

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[*] Pamphlet entitled "Explanation of the Principles of distributing the Surplus Fund of the Scottish Life Assurance Society, suggested in the Report of the Committee. By Mr Patrick Cockburn. January 1832."—The italics are in the original.

TABLE of a Society's Stock,—the Annual Contribution for Sickness being L.1, and Weekly Sick Allowance L.1.029725, or L.1 : 0 : 7 ; and the Annual Funeral Contribution being likewise L.1, and the Sum payable at Death L.59.9584205, or L.59 : 19 : 2.

The sums in column 14. of the Table at page 136. are those given in column 3. of this Table, which, being multiplied by the number of members in column 2, give the amounts in column 4. The sums in column 5. of the Table at page 140, are those given in column 5. of this Table, which, being likewise multiplied by the number of members in column 2, give the sums in column 6. The summations of columns 4. and 6. are of course the amount of capital required.

Ages.	Number of Members.	SICKNESS CAPITAL		FUNERAL CAPITAL	
		For each Member.	For all the Members.	For each Member.	For all the Members.
22	11	£0 8 6¾	£4 14 2¼	£0 8 4¼	£4 11 10¾
23	12	0 17 6¾	10 10 9	0 17 0½	10 4 6
24	13	1 6 11½	17 10 5½	1 6 0¼	16 18 3¼
25	14	1 16 9¼	25 14 9½	1 15 3¾	24 14 4½
26	15	2 7 0	35 5 0	2 4 11½	33 14 4½
27	16	2 17 7¾	46 2 4	2 14 11¾	43 19 8
28	17	3 8 8½	58 8 0½	3 5 4¼	55 11 0¼
29	19	4 0 2½	76 3 11½	3 16 1¾	72 6 9¼
30	17	4 12 1½	78 6 1½	4 7 3¾	74 4 3¾
32	15	5 17 2¾	87 18 5¼	5 11 0¾	83 5 11¼
34	13	7 4 5¾	93 18 2¾	6 14 1	87 3 1
36	10	8 13 9½	86 17 9	7 18 10¾	79 8 11½
38	8	10 5 3¾	82 2 6	9 10 6¼	76 4 2
40	6	11 19 7½	68 17 9	10 13 4½	64 0 3
42	4	13 16 2	55 4 8	12 1 11	48 7 8
45	3	16 13 9¾	50 1 5¼	14 9 2¼	43 7 6¾
48	2	19 12 2¾	39 4 5½	16 18 5	33 16 10
50	2	21 9 0¼	42 18 0½	18 14 8¾	37 9 5½
52	2	23 4 6¾	46 9 1½	20 12 11	41 5 10
55	1	25 12 9	25 12 9	23 14 5¾	23 14 5¾
Total,	200		£1032 0 9½		£954 9 5

Thus, the Society ought to have in the Sickness Fund,	£1032 0 9½
Do. in the Funeral Fund, ...	954 9 5
Total estimated Capital,	£1986 10 2½
Suppose, again, the funds in possession to be . . .	£2104 17 6½
Quarterly accounts and fines due, ...	45 12 3
Value of copies of Regulations on hand, ...	10 15 6
Sum of capital actually in possession and in arrear,	£2161 5 3½
Therefore, by deducting the above estimated capital of .	1986 10 2½
There would remain, for defraying incidental expenses and meeting any unforeseen contingencies, a surplus of	£173 15 1

The method adopted in the foregoing table, however, would not altogether answer for societies who admitted members at all ages without an equalizing entry-money, but merely upon payment of an increased annual contribution. In that case, one way of calculating the stock of each individual in the sickness scheme, for example, is as follows:—

It is wished to be known what stock a society should be possessed of for a member who entered at 21 years of age, who is now 30, and who has paid the standard annual contribution of L. 1, in the interval of these ages.

The value of the future distributions to a member aged 30, (by the table, p. 136. col. 16.) is - - - L. 21.3011

If he entered at 21, and is paying an annual contribution of L. 1, the value at 30, (col. 15.) of his whole future contributions, is 16.6944

And the difference (col. 14.) is his stock or interest in that fund, of L. 4.6067

Again, it is wished to be known what should be the stock for a member who entered at 30 years of age, who is now 40, and who has paid the increased annual contribution of L. 1.27594 (col. 17) in the interval of these ages.

The value of the future distributions (col. 16.) to a member aged 40, is - - - - - L. 26.5806

The value at 40 of a future payment of L. 1, (col. 15.) is L. 14.5993

The annual contribution payable by a member entering at 30, (col. 17.) is - - - 1.27594

The one being multiplied by the other gives the value of this member's future contribution at the age of 40, which is - - - - - - 18.6278

And this last being subtracted from the value of his future allowances at that age, the difference, or his interest in the capital at the age of 40, is - - - - L. 7.9528

Having, in this way, ascertained the estimated stock of each member at every age in the society, and added the whole sums together, the total amount would of course be the capital required.

But it is very probable that neither of the above methods may be entirely applicable to every society, as the requisite amount of capital must always depend, more or less, upon a variety of circumstances, with regard to the value of the future coutributions and allowances, which it is impossible here to enumerate or foresee, but which must be taken into account at the time of balancing. Our object at present is not so much to give rules for performing these operations as to shew their expediency; and if societies once become convinced of the necessity of entering into periodical investigations of their affairs, they will have recourse for directions to some of the works on annuities *, or to persons practically acquainted with the subject. It is to be particularly observed, however, that, in performing such operations, it will not do to take the average age of *all* the members of a society, and hence conclude that the sickness and consequently the demands, will be the same as if each member were of that age. For example, take one member at 25 years of age, one at 35, one at 45, one at 55, and one at 65, the average *age* of each of these five members will then be 45, but their average *sickness* will be much more than if each of them had been in reality 45 years of age. Thus, the average sickness of a member at 25 years of age, is 4 days 3 hours; of one at 35, 4 days 19 hours; of one at 45, 1 week 4 hours; of one at 55, 1 week 6 days 3 hours; and of one at 65, 5 weeks 4 days 10 hours, being in all 9 weeks 6 days 1 hour; which being divided among these five members, give to each 1 week 2 days 6 hours, while the average sickness to a member at 45 years of age is only 1 week 4 hours, or about one-third less. This will shew how the sickness and claims against a society may increase, although the average age of the members, when taken as a whole, may continue nearly the same for a long series of years.

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* See the works of Price, Bailey, Milne, &c.

It may only farther be remarked, with regard to fines and payments in arrear, and calculated on above as stock, that such debts are really as beneficial and secure as if the money were actually in the society's possession; for they must be either all paid within a limited time, and that, too, in general, with high interest in the shape of additional fines, or forfeiture of the whole previous payments is incurred. These debts are therefore equal to the same sum in possession, and as they will always form a considerable part of a society's capital, the strictest attention would require to be paid to the book-keeping. Indeed, it will be now obvious, from what has been stated, that this is at any rate indispensable, for no Friendly Society can ultimately succeed whose books do not afford means of ascertaining the amount of the engagements to the members by the society, and its ability or inability to meet them. For many suggestions in this department, as well as for much useful information on other matters connected with Health and Life Assurance, we have been indebted to Mr James Cleghorn, accountant in Edinburgh, whose practical acquaintance with all that relates to such subjects has been likewise of the greatest service to several societies lately established.

But highly important as proper books and periodical investigations are for securing the permanency of societies and the due fulfilment of their obligations, such books and investigations are no less important in another point of view. By their means members will be always made aware of their real interest at any age in the capital, and will thus often be prevented from allowing themselves to fall into arrear in their contributions, and be expelled for non-payment, which might have otherwise been the case, had they not known the value of the right they were sacrificing. And here we must take notice of what is considered a most oppressive measure, which has of late been extensively resorted to by societies against forfeited members, and sanctioned by the inferior judicatories,—we mean prosecution for arrears. In order to enable the reader to form a proper conception of this matter, it will be necessary to give, first, a brief summary of some proceedings which have lately taken place; and then to state what is conceived to be the real merits of the question.

Proceedings of the Justices of the Peace in the cases of Forfeited Members of Friendly Societies.

A few months ago there appeared in the newspapers the report of a suit raised by a Friendly Society at Ellon, in the county of Aberdeen, against some of its members, for payment of no less than fourteen years alleged arrears, and in which it was stated, that the circuit court, upon an appeal, had decided against the members to the extent of the first two years' dues, being the period during which they were entitled to benefit. For some considerable time previous to this decision, similar cases had frequently occurred in the Justice of Peace Courts, but the judgments were often so inconsistent and contradictory, that no fixed rule of decision could be said to exist, and prosecutions were by no means general. In consequence of the report of the above decision, however, the question was considered to be settled in favour of the societies; and, therefore, several of these institutions in Edinburgh immediately came to the resolution of demanding from all who had been at any time connected with them, payment of whatever sum appeared from the books to have been unpaid at the time they ceased to be members, and for the non-payment of which they had suffered the stipulated penalty of expulsion and forfeiture of all previous contributions to their respective societies.

Numerous prosecutions having next been threatened for non-compliance with these demands,—which were considered to be both iniquitous and illegal, and which, if successful, would be productive of the most serious consequences to great numbers of working people,—application was made for information as to the particular grounds of decision on the circuit. From the information thus obtained, it appeared that the case at Ellon had been decided under particular circumstances, and that it could not therefore be held as a precedent; and, at any rate, that the equitable principles of accounting applicable to such cases, had never in any question been taken into consideration, but that both societies and judges had acted merely upon the principle, that as long as a member is entitled to claim benefit, so long is a society entitled to compel payment of his dues. It being evident that this general rule had been adopted and indiscriminately applied, without any regard to the particular circumstances in which each society might be placed,—the conditions upon which the members had entered,—the peculiar nature of societies' operations,—or to their own printed regulations,—a case explanatory of the whole was drawn up and circulated among the gentlemen composing the Law Committee of the Justices of the Peace for the county of Edinburgh. In this statement it was shewn, 1*st*, That the contributions of members are always paid in advance; 2*d*, That each member has always a greater interest in the stock than any sum of contribution he is ever allowed to run in arrear, and hence that every society is greatly benefited by each forfeiture that occurs; 3*d*, That such forfeiture was in general the only penalty for non-payment, either stipulated or enforced by the regulations or practice of Friendly Societies; and, 4*th*, That their former members could not therefore be now called upon, at the distance of months and years, to pay what neither the one party nor the other ever before conceived to be due. The Justices, however, stated,—upon a special case being brought to try the question, and to which the above objections particularly applied,—that they could not coincide with the statements which had been made, as they held, that when a man became a constituent member of a Friendly Society, his contributions could no longer be considered his individual property; that, as long as a member was entitled to benefit, he was bound to pay all the stated contributions; and that having the decision of a judge of a supreme court before them, they could not do otherwise than take his opinion as their guide.

The result of this case having also been made public through the medium of the newspapers, prosecutions immediately became general throughout the whole of Scotland, but more especially in the capital and its vicinity. In the Justice of Peace Court of Edinburgh, there were sometimes thirty and forty such cases in a day; and the extent of oppression and injustice to which these measures led can hardly be imagined. Numbers of poor people, after having contributed to these societies for a long series of years, became unable, in the late distressing times, to continue their payments, and were consequently not only forced to surrender the whole that they had provided for sickness and old age, but also subjected to imprisonment for non-payment of what was called arrears. Others, again, who had contributed for as long a time from mere feelings of benevolence, who had never received, nor intended to receive, any benefit, and who had left the societies from inadvertence or otherwise, were now dragged before these courts, and decerned against for whatever sums were demanded as arrears. By the statute 6th Geo. IV. cap. 48, under which the Justices act as a small debt court, it is ordered, that "a copy of the account, document of debt, or state of the demand, shall be delivered by a constable or peace-officer, to the defender personally, or left at his dwelling place;" and in the very summonses issued from the Justice of Peace Court, there is the following "*N. B.* The Justices strictly enforce the provision of the act which requires a copy of the account, document of debt, or state of the demand to be delivered to the defender, at the time he is summoned." When such accounts were called for, however, the act of Parliament produced, and the note in the summons referred to, the court decided, in no fewer than six different cases, that such objections were frivolous, and intimated that they were determined to enforce payment of these arrears, and to support Friendly Societies by every means in their power, as they considered them most valuable institutions. But the defenders having threatened actions before the Supreme Court, if these decisions were enforced, a farther hearing took place, and several of the Justices at length began to express doubts of the equity of such decisions. With regard to this particular society, it was found that the question ought to have been tried in another court; and the cases were accordingly remitted to that of the city Magistrates; but with regard to numerous other cases, it was deemed prudent, in the mean time, to delay deciding them, until their merits should be farther considered, and proper advice obtained. The city Magistrates having followed the same course, the matter remains for the present unsettled *.

Such, then, being the nature and supposed difficulties of these questions, it is trusted that the following additional detail will not be considered as altogether superfluous for their farther elucidation.

At the commencement of every Friendly Society, a number of individuals agree to contribute each a sum as entry-money, and afterwards a quarterly contribution for one, two, three, or more years, before any of them shall claim or be entitled to benefit; and should any one die or withdraw before the expiration of the stipulated term, all his contributions become the property of the society. It is also agreed, that each member shall be allowed an indulgence of four or five quarters before he can be expelled for non-payment; and such non-payment has been uniformly the only intimation ever given or required, when any member intended or was obliged to leave the society. These are usually all the stipulations with regard to contributions, resignation, or expulsion, and of course apply equally to the future as to the original members.

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* Friendly Societies in England are now pursuing the same measures. One society in London very lately summoned twenty-seven of its late members for arrears; but the Magistrates, from the importance of the question, also delayed giving any decision. See the London *Trades Free Press* newspaper, 24th May 1828.

Before a member, therefore, can become *free*, or entitled to benefit, he must have paid, besides entry-money, one, two, or three years' contributions in advance; and it is out of these, that the society afterwards defrays the allowances, in the first place, until they be again replaced, and generally more than replaced, with the interest of the remaining capital, and the future contributions as each quarter-day arrives. (See table p. 136, cols. 13, 14, &c.) Should any member fail to pay regularly, he is charged high interest, in the shape of a fine, for each neglect, until the period of forfeiture; and should he fall sick or die before forfeiture, the arrears and interest are deducted off the first of his allowances.

It will thus be seen that no society can ever run any risk of loss by members in arrear, it being out of the *advanced* or *past* contributions that all their claims fall to be defrayed,—that the current contributions, or those in arrear, are deducted by the society off the first of their allowances, should any such be required,—and that, should a member be ultimately expelled for non-payment, the society is much more than repaid, by retaining the whole of his subscribed capital before he became free, together with his share of any accumulation which may have afterwards taken place.

If any farther proof of the accuracy of these remarks were wanting than that afforded by the tables and explanatory observations on p. 136, *et seq.* we would particularly refer to Mr Cockburn's lucid statement, as quoted on p. 143-4.

It is said, however, that as a society has the risk of a member's sickness and death during the period he is in arrear, so it is but equity that he should make payment of such arrears, and then, if he chooses, withdraw from the society. In a *proprietory* assurance company, where the assured have no interest in the capital, were an insurer indulged with a delay in payment of his premium, at the same time that the company held themselves bound to him during the interval in benefit, such a rule would be just; but if, on the other hand, this same person held a share in the concern to a far greater amount than the sum he fell in arrear, it would not surely be attempted, upon his ultimate failure in payment, both to seize his capital, and also to prosecute him for his premium. But this is exactly the course which is now proposed to be adopted by Friendly Societies, for as these institutions are mutual assurance companies, every member has a share in the capital; and before any one can be entitled to claim benefit, his share must exceed the amount of any arrears which he can ever be due. This stock arises, as before stated, first from his contributions before becoming free, and next from the progressive increase of the fund. (Table, p. 136 & 140.) He, therefore, at the beginning, advances money on the faith of the society, while the society, on the other hand, allows him to run in arrears on the security of his stock; and, as already mentioned, a forfeiture of such stock is incurred, if these arrears are not paid within a specified time.

But it has likewise been said, that were a member to fall sick while in arrear, he might soon draw out from the society a great deal more than his share of the capital. This argument, however, might as well be applied to members who are regular as to those who are not regular in their payments. It is the very intention and use of such societies, that some members shall receive much more than others; and it will not surely be pretended, that, without some special agreement, those on whom sickness has fallen would not have the same right, ages and payments alone being considered, to an equal share of the stock, in the event of a subsequent division, as those who had never received a farthing. As all the members, therefore, continue to have an equal right to the capital, (in the old societies at least), so long as they are connected with the institution, and as the managers can always retain payment of all arrears off the allowances in the event of sickness or death, a society, even in this point of view, runs no greater risk with a member in arrear, than with one who is not.

Every Society, therefore, is greatly benefited by every surrender or forfeiture that occurs; and this is so well known by all the higher classes of Mutual Assurance Associations, that very considerable benefits are always calculated upon, and do arise, from such forfeitures, although with them no entry-money, and only *one* year's contribution, is paid in advance.

But, farther, the practice of retaining all the stock of a member who wishes or is obliged to withdraw, has been even acknowledged by the more respectable assurance associations to be unjust; and, accordingly, the greater number of them are now in the habit of purchasing the policies (*i.e.* returning so much of the past contributions) of such members as may find it inconvenient or unnecessary to remain any longer in the institution.

In the Report, too, of the Highland Society, while it is stated that forfeitures appear to be indispensable in Friendly Societies, being the only practicable means of enforcing regular payments of small contributions, it is added, "were Friendly Societies once established upon correct principles, and accustomed to ascertain periodically the value of the individual stock of their members, it might deserve consideration whether it would be expedient that the directors should have a discretionary power to purchase up, under some regulated abatement, the interest of members who are going abroad, or who have become permanently established at such a distance as renders inconvenient the maintenance of their accustomed relations with the society. An arrangement of this kind would obviate a general objection which frequently leads young men to postpone to a more advanced age their entering into societies*."

Several Friendly Societies lately organized have accordingly adopted this regulation. Heriot's Benefit Society, for example, (whose rules were sanctioned by the Quarter-Sessions of the Peace for the county of Edinburgh 21st November 1826), give a table, shewing the pecuniary interest of each member at every age in the society; which is for one at thirty L. 3 : 5 : 1; at forty, L. 8 : 6 : 5; at fifty, L. 14 : 16 : 5, &c.; and, should circumstances render it necessary for any one to leave Scotland, he may either continue a member, or, upon relinquishing all future claim, receive three-fourths of his stock at the time, after deducting all arrears.

The Edinburgh School of Arts Friendly Society, an institution just established upon the most accurate and scientific principles, has also stated in their regulations, that, if any member satisfy the committee that he is *unable* to continue his contributions, or is about to leave Scotland, and wishes on that account to dissolve his connection with the Society, "the committee shall be authorized to purchase the interest of any such member for a sum not exceeding two-thirds of the value thereof, according to the age of the party at the time, the state of the funds at the last period of investigation, and the tables of the Society." For example, an individual who entered at 21 years of age, and who has two shares in the Sickness Fund, three in the Annuity, and five in the Life Assurance or Funeral Fund (the annual contributions being payable till the age of 65), will, at the age of 36, have an interest in the stock of the society to the extent of L. 34 : 16 : 10¾, and should he then withdraw, under either of the above circumstances, he will be entitled to two-thirds of this sum, after deduction of arrears.

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* Report, p. 89.

But, supposing that no part of the capital were to be returned by either of these societies to members unable to continue their payments, would it not be most iniquitous to prosecute, after forfeiture, such members for arrears, while there had been confessedly retained by the society a sum more than equal to *six* times the amount? Now, although old societies have no books or tables by which they can exhibit the interest of their members so clearly as the above two societies, yet it may, to a certain extent, be shewn otherwise; and the case of the society already alluded to, as having been brought before the Justices to try the question of arrears, may be taken as an illustration. This society was instituted in 1750; and by the last edition of its articles, printed in 1822, a man entering at the age of 31, would pay, before the society ran any risk with him, entry-money, L. 2; regular contributions for three years at 2s. 6d. per quarter, L. 1, 10s.; six funerals annually * (the average for some years) at 6d. each, for three years, 9s.; fines, say at least 1s.: in all, L. 4. Here, then, the advanced capital of this member is no less than L. 4 sterling, besides interest, at the end of three years; and this sum ought also to increase, by the unappropriated balances of the subsequent contributions and accruing interest, for at least ten years afterwards. But supposing this member, from want of employment, or any other cause, to run in arrear during the fourth year,—to be unable to pay within the limited period,—and to be expelled for non-payment of L. 1,—would it not only be excessively unjust, but cruel in the extreme, to oppress him for payment of this sum also, while he had been obliged to surrender four times the amount? And supposing that he had fallen sick or died while in arrear, the society could in no possible view have been in a worse situation with him than if he had paid his dues at the previous quarter day; since, as formerly remarked, they had his past contributions in their own hands, and also the power of retaining his arrears off the first of the allowances. Above all, had this member been struck off the roll for non-payment, before he became free, but after he had paid his entry-money, and perhaps eighteen months' contributions, upon what pretence could the society prosecute him for arrears, while they held these sums in their possession, and had never in any shape been liable to him in benefit?

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* In old societies the practice was, and still is, only to contribute for funeral allowances as the deaths occurred; but this absurd plan is of course not adopted by such new societies as are established upon proper principles.

But without entering more into detail as to the equity of the case, it may be remarked in general, that were it an established rule of any society, that members could only resign by written intimation, and upon paying all arrears, it would be proper, whether such law was equitable or not, that all should be made to comply with it, until regularly altered. But where no such regulation has at any time existed, and where the only notice of resignation ever given or required, during a long series of years, has been that of non-payment, surely no society ought to be authorized to enact, or at least to enforce, a law, which is not only to operate against members in future, but also against persons who have ceased—and some of them for many years ceased—to have any voice or interest in its concerns. It is a well known maxim, that practice is held to explain any law already enacted, and that every new law can only have a prospective not retrospective effect, without the consent of all interested.

In short, if questions between Friendly Societies and their members are not to be decided by their own regulations and practice, all their calculations—all the parliamentary enactments and late inquiries—as well as all the trouble which the Justices themselves are put to in revising and sanctioning such regulations, will be rendered of no avail.*

We now conclude these desultory remarks on Friendly Societies, and the object in submitting them will be attained, should they in any degree tend to direct more general attention to the utility and principles of these institutions. The works wherein the subject is more ably treated have been referred to; and it is with pleasure we have to add, that another treatise on it will soon appear, through the medium of a well known work, THE LIBRARY OF USEFUL KNOWLEDGE.

* Since this sheet was put to press, the cases stated on p. 149. to have been remitted by the Justices of the Peace for the county of Edinburgh to the Magistrates for the city, have been decided. Upon giving judgment, the Magistrates said that they would candidly confess that they were now of a quite different opinion from what they were when the cases were last before them. Conceiving the question to be one of much importance, they had since that time paid considerable attention to the subject, and had taken the opinions of several professional gentlemen, and more especially those of the city assessors or legal advisers, as to the right of the society to enforce payment of arrears from forfeited members. The result was, that the court had now no hesitation in agreeing with all those gentlemen, that the society had no such right, as there was no article in their regulations, neither had there been any instance in the practice of the society for seventy years, authorising such demands. The defenders were therefore assoilzied from the actions, but no expences were found due.—We trust this decision will put an end to these unjust prosecutions, and that it will lead both societies and judges to pay greater attention than hitherto to their regulations, in deciding any disputes that may arise. This is the more necessary, as, from societies now granting more extensive and varied benefits, and the interests of all parties being consequently much increased, questions will frequently occur, not merely regarding a few shillings, but regarding annuities and allowances at death, the *present value* of which may amount to very large sums.

[Mr Fraser's Memoir on Friendly Societies, now brought to a conclusion, we consider one of the best views of this highly interesting and important subject hitherto published. Already it has excited much attention, and we doubt not will materially assist in extending these very excellent institutions throughout the country.—ED.]

On the Velocity of Sound. In a Letter from G. VON MOLL, F. R. S., Professor of Natural Philosophy in the University of Utrecht, to Professor JAMESON.

SIR,

IN the Number for October of your valuable Journal, Mr H. Meikle notices the observations on velocity of sound, which were made by Mr Van Beek and myself, and an account of which was published in the Philosophical Transactions of 1824. Mr Meikle very justly states his apprehension that some of these observations are erroneously mentioned, as having been made in *January* instead of *June*.

On receiving your Journal, I immediately turned to the Transactions, and found, to my no small mortification, that Mr Meikle is perfectly correct. The error which he points out really exists in the Transactions, by whose fault I am unable to tell. Whether I, or the printer, is guilty, is impossible for me to investigate. If the fault lies with me, I cannot plead in excuse the cause which Mr Meikle kindly suggests. It cannot have arisen out of ignorance of the language, since *Juny* and *January* belong alike to both idioms. It is therefore a blunder; and I must request you to correct the effect of it as much as possible, by informing both Mr Meikle and the public, that all the experiments alluded to were made in *June*, and none in *January*.

If I were in possession of the apparatus pointed out by your able correspondent, I should be very anxious to try its efficiency; and if Mr Meikle has had one made, I should be very much obliged to that gentleman for the information where a similar one could be procured. I am, &c.

G. MOLL, F. R. S.,
Professor of Natural Philosophy in
the University of Utrecht.

UTRECHT,
28*th February* 1828.

Mr Meikle apprehends that the cause why the interval was longer in the experiments of 25th June, than the mean of both directions on the 27th and 28th, must lie in the difference of the guns, or of the mode of charging and firing them. In turning to the diary of these observations, I find that the 25th, 27th, and 28th of June, the long metal twelve-pounders have been used on both stations, loaded with six pounds of gunpowder. The cartridges had been carefully prepared by Sergeant-Major, now Captain or Lieutenant Essen?; the gunpowder, if not from the same barrel, was from the same magazine. The propriety of trying its strength did not then occur to us. The guns were constantly discharged, loaded, primed, and managed, by the same persons, either non-commissioned officers or cadets. The cartridge-bags were of fustian, and not of paper. Instead of wadding, a sod was rammed down on the charge as strongly as possible. I cannot therefore see any of the differences pointed out by Mr Meikle. I had the observations of Captain Parry and Lieutenant Foster in high latitudes, and low temperature, reduced to the same pressure and temperature with our own experiments. The results agree strikingly: an account of this will be shortly published in the Transactions.

Mr Meikle, in reply to this communication, has sent us the following remarks.

With regard to the proposed apparatus, it has not yet been constructed; but I have had some correspondence with Professor Moll on the subject, and it is probable that an arrangement will be made for following up the scheme; especially as I have suggested some material simplifications on the original proposal—particularly that, instead of placing such an apparatus or clock, at each end of the range, it would be preferable to have only one in the middle, or somewhere in the line between the observers. By this means, the ear would not be so overpowered by the prodigiously louder sound of the bell beside it, than of that it was meant to hear. By placing observers, too, on opposite sides of the machine, both in the line of the direction of the wind, and also in another at right angles to it, the effect of the wind could be ascertained; and that, perhaps, even when the sound could not be heard to windward;—a method which, for several reasons, could scarcely be made available in the case of cannon.

As to the conjectures, which I formerly threw out, to account for some slight anomalies in Professor Moll's experiments, it never occurred to me that the two guns, so judiciously employed by that distinguished philosopher and his able associates, were such as would either be accounted of different sizes, or reckoned to be differently charged, &c. What I alluded to, was merely small or accidental discrepancies in their dimensions, and in the modes of operating peculiar to different individuals. For, though Dr Moll says the guns were constantly discharged, loaded, &c. by the same persons, yet he must mean only the same rank or description of persons—not the same individuals; because the guns were fully nine miles from each other, and discharged nearly at the same time. Besides, if the sods, strongly rammed down instead of wadding, presented the same resistance to the powder in both guns, I should rather deem it an accidental coincidence. At the same time, I am perfectly ready to admit, that I do not see how the mode of experimenting with guns could have been better managed than was done by Dr Moll and his associates; and I consider their results among the most valuable we possess.

In experimenting with cannon over great ranges, the intensity or loudness of the sound must at first be very great, and then gradually decrease toward the farther end of the range, where it has in some instances been so faint as to be quite inaudible, when opposed by a very slight wind. But since the results so obtained are only the *mean* of the velocities over the whole range, they throw no light on the question, whether, or how far, loudness affects the velocity. It is, besides, highly probable, that such a *mean* velocity from cannon may often happen nearly to agree with the *mean* from a bell, and yet, for all that, sound be really moving with a *retarded* velocity, or slower as it gets fainter. If, during experiments with cannon, additional observations were made somewhere intermediate between the extremities of the range, possibly a solution of the question might, to a certain extent, be obtained, by comparing the times with the corresponding portions of the range. But the difficulty of measuring these minute intervals of elapsed time with sufficient exactness would here come into play, unless something like the apparatus formerly suggested were adopted. By means of that method, the minute intervals may be ascertained with such facility, that several observers could be ranged at various distances from the sonorous body, which could scarcely fail to shew whether the velocity be uniform, or retarded.

Guns with percussion locks, it is true, could be set off in succession, by means of clock-work; but it would be nearly impossible to make one and the same gun fire at sufficiently short equal intervals; and I rather doubt if two guns be often of precisely equal dimensions. To be sure, this might be examined and rectified if necessary, though not without considerable trouble. However, granting that any inequality of size were obviated, or did not exist, a more insuperable uncertainty remains; for we cannot be sure that two charges, even those used successively in the same gun, are so perfectly alike, so equally ignited, and so equally resisted by the wadding, or whatever else is used for the purpose, as to give exactly equal reports. It is true, that, in the late experiments in France, the velocity of sound was the same, whether two or three pounds of powder were used; but where powder has nothing to propel, a great part, especially of a larger charge, escapes unburnt. For such reasons, the method of striking a bell at short equal intervals by clock-work, though confined to a smaller range, possesses a precision of principle which can scarcely be looked for with guns.

Perhaps to the sources of acceleration formerly suggested, should be added, the sudden gust of wind caused by the great burst of flame, &c. from the mouth of the piece. H. M.

Some Remarks on the Bushmen of Orange River. By LOUIS LESLIE, Esq. Assistant Surgeon, 45th Regiment. Communicated by Sir JAMES MᶜGRIGOR, Director-General of the Army Medical Board.

THE military post at Orange River being abandoned, the same opportunities may not again be afforded to another, of observing the manners of the Bushmen, and giving to the Medical Board some account of their poisoned arrows. In that neighbourhood, and along the Hornberg?, purer examples of that extraordinary race are perhaps nowhere to be found; and whatever follows, regards only them, and may differ from any account of other portions of the tribe along the African frontier. Small in stature as the Hottentot race is, they are, in the quarter mentioned, less than any where else, seldom exceeding five feet, but of the most perfect symmetry; they are active in their movements, but indolent in disposition; their colour is dark, but is rendered still darker by filth; their features are peculiarly forbidding, on account of the great distortion of the bones of the face; and the facial angle approaches considerably to that of the monkey. The Bushman will seldom submit to coercion and restraint,—if he does, he becomes the Boor's most wretched menial, and perhaps is worse treated than any slave in the world. In the state of liberty, they dwell in craals, under the authority of a chief, whose rank is among them hereditary. The number in one craal seldom exceeds thirty—men, women, and children. Their dwellings are formed of mats, if in the plain, just large enough to creep into; but they often reside in a high and ridgy mountain, under some projecting ledge of rock, the approach to which is narrow and difficult. If attacked there, they seldom flee. They have no fear of death; and, if possessed of a more powerful weapon, might defy the attacks of the Boors, make them less frequent, and more fatal. Nothing but the privations they suffer would make any one of them submit to the cruelty of the farmers; and, living as they do on locusts, ants, and some farinaceous roots, there can be no better proof of the insufficiency of their tiny bow, and of the general inertness of their celebrated poison; yet they are themselves impressed with the conviction of its strength, and they have been able to impress their enemies with a dread of its effects, if not of its fatality. I have never been able to procure one well authenticated relation of death produced by it in man. I have known some cases of horses and dogs dying from the insertion of the arrow into the leg; but some of them seemed to die rather from the effect of violent inflammation in the limb, than from any specific power in the poison itself. In one instance of a dog, however, the animal became stupid and insensible in a few minutes, and died in twenty. Some colonists who have been wounded, assert that they are subject to periodical attacks of insanity, under certain states of atmospherical influence; but I believe this to be, like most of their tales, quite unworthy of credit. The poison of the Bushman of the Hornberg? is extracted from plants, and from plants only, so far as I have been able to learn. In that quarter, they use no mineral poison, nor the venom of snakes. Two specimens of plants used by them accompany this; the bulb is a species of the *Hæmanthus*; but never having seen the other plant in flower, I have been unable to learn its name. Its leaf exudes a milky juice, and, cut up and boiled, forms a tenacious extract, which is spread upon the arrow, to some thickness. There is another plant which they use likewise, either above or with the other two; which, together, forms the strongest they procure; its name is "mountain poison." Growing on the stony hills, and very rarely to be found, I have never got a specimen of it.

Their dexterity in the use of their bow is remarkable, and the distance they can shoot, with such a light arrow, is astonishing.

They will throw the arrow upwards of an hundred yards, and with great correctness; but, as might be expected, it will seldom wound at such a distance; and I have known a cavalry cloak protect a soldier at twenty paces. The bow is not brought to the eye in shooting. They fix their eye upon the object, grasping the bow with the left hand, while the arrow passes through the fingers on the right side,—a mode of shooting I believe peculiar to them.

Their treatment of a wound made by a poisoned arrow is truly scientific. It is laid freely open, the poison cleaned out, and a horn applied in the manner of a cupping-glass, exhausted by suction at the small extremity. This, as far as I could learn, is the only treatment they adopt, never making use of any herb as a specific. The Boors consider gunpowder and urine as very efficient, and prescribe those in every arrow wound, and in every case of snake-bite. Cupping would seem to be the Bushmen's favourite treatment of every complaint accompanied with pain, and so frequently do they resort to this, that by the time they are full grown they appear scars all over.

The length of time a Bushman can live without food is surprising, often living for three and four days without a mouthful; and the quantity they can devour after such abstinence is equally remarkable, one man having been known to eat an African sheep (30 lb.) in a single night. When unable to procure food, a belt round the body is tightened as the craving increases, and they resort to the smoking of *dakka* (a species of chanvre, or hemp), which produces intoxication. The narcotic effects of this plant no doubt produce much of that shrivelled appearance which is observable in all of any age. When possessing plenty of their *dakka*, they can smoke and sleep for several days and nights without eating.

A Bushman has no idea of the perpetuation of property; I might say, no notions of a prospective existence. He is wholly dependent on nature or on man: he will neither imitate the Caffer nor the Boor, will neither grow corn nor breed cattle.

The figures drawn by them on the rocks are often remarkable for the correctness of the outlines; they hit the attitude of the animal, but seldom care about truth in colouring: speaking phrenologically, they have the organ of form, but not of colour. I have never seen any animal resembling the unicorn among their paintings, but such an animal is said to exist beyond the Orange River. They are fond of music and dancing, but their musical instrument is rude, and without power or variety, consisting of one string stretched upon a bow, whose vibrations are produced by the breath, with great exertion.

The Bushman's conception of a Supreme Being is, that he is an evil deity, and their notion of futurity, that there will be an eternity of darkness, in which they will live for ever, and feed on grass alone. They imagine that the sun sends rain, and when he is clouded, they hold up burning wood, in token of disapprobation. They believe that the sun and moon will disappear, to produce the darkness they anticipate.

The Bushman's bow is made of a peculiar tree, called the Blue Bush, whose branches are almost moulded by nature to the artificial form. The sinews of the quagga yield powerful bow-strings, and the arrow is formed of a slender reed, headed with antelope's horn, and pointed with a small triangular piece of metal, which they procure from the Caffers.

Observations on the Structure of the Heart of Animals of the genus Rana. By John Davy, M. D., F. R. S. Communicated by Sir James McGrigor, Director-General of the Army Medical Board.

It is commonly asserted by the highest authorities in comparative anatomy, and generally believed, that the animals belonging to the genus Rana, and indeed all the animals included in the natural order 'Batraciens', of M. Cuvier, have a single heart like fishes, composed of one auricle only and one ventricle.

Many observations which I have made on the common toad, have led me to a different conclusion, and have satisfied me to demonstration that the heart of this animal has two auricles.

This structure is displayed without much difficulty by minute dissection. It is best exhibited by making a transverse incision into the ventricle, close to its base, and inflating the cavities with the blowpipe. In this way, and using fine probes, it may be demonstrated clearly that the heart has two auricles, divided by a transparent membranous septum, possessing fibres that appear to be muscular; that these auricles communicate with the ventricle by a common and very short passage, provided with three semilunar valves; and that they have no possible communication with each other, excepting through the passage above the valves common to both of them.

The same fact as to structure may also be demonstrated, by blowing air through either of the two pulmonary veins, which return the blood from the lungs to the heart. The pulmonic auricle, the smallest of the two, is thus distended, and not the systemic; or, by blowing air into the large sinus into which the venæ cavæ terminate, when the reverse of the preceding experiment takes place; and this, at the same time, shews that the margin of the septum acts as a valve, and must prevent the blood of one auricle passing into the other.

But, even did not the margin of the septum perform the function of a valve, the blood from one auricle could not pass into the other, the contraction of the two being synchronous; the auricles first contracting, next the body of the ventricle, and, lastly, that part of the ventricle of a conical shape, which may be considered almost as a second ventricle *.

I have observed the same kind of structure of heart in the bull-frog and the common frog. Whether it exists in all the other species of the genus, I have not ascertained, but most probably it does; and, reasoning from analogy, the probability is very strong that all the other genera of the order 'Batraciens' have a similar conformation, both of this vital organ and of the

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* I am almost induced to consider this part as a second ventricle, from its peculiarities, which I am not aware have hitherto been noticed. It is separated from the body of the ventricle by three valves, of a semilunar form. To the side of its cavity is attached a fleshy projection, or moveable septum, above which it gives origin to four arterial trunks, viz. two aortæ and two pulmonary arteries, the former considerably larger than the latter, each provided with its own semilunar valve; and the action of this part seems to me to be as peculiar as its structure. When I have watched it, it did not appear to contract simultaneously, but first one-half and then the other; as if intended, in conjunction with the various anastomoses of the arterial system, to preserve a constant, though small, current of blood, to supply all the parts of the body according to their various demands.

sanguiferous system in general *. Should the inference prove correct, and its truth established by observation, these animals, in their mature state, will no longer be an anomaly in the classification of reptiles, on account of their heart; and they will still continue as a link connecting the reptiles with fishes, by the peculiarities of their respiratory organs in the first stage of their existence.

CORFU, *July* 2. 1825.

Notice in regard to the Jaculator Fish of Java, or Chætodon rostratum, Lin. By JAMES MITCHELL, Esq. Surgeon, R. N. Communicated by the Author.

WHILST residing in the Island of Java, in December 1822, I heard of an extraordinary species of fish, in the possession of a Javanese Chief, who lived within a mile of the town of Batavia.

Accordingly I went to see it, in company with Mr Johnson, the commander of the ship Guildford, in which I was a passenger, and with an interpreter.

On our arrival at the chief's villa, we were treated by him with great courtesy. After conversing with him some time he permitted us to visit his gardens to see these fish, upon which he placed a high value, and would on no account part with one of them.

The fish were placed in a small circular pond, from the centre of which projected a pole upwards of two feet in height. At the top of this pole were inserted small pieces of wood, sharp pointed, and on each of these were placed insects of the beetle tribe. The placing of this pole and insects by the slaves had disturbed the tranquillity of the fish, so we had to wait some considerable time before they began their operations; but this delay was amply recompensed by the amusement they afterwards afforded us. When all had been tranquil for a long time, they came out of their holes, and swam round and round the pond. One of them came to the surface of the water, rested there, and after steadily fixing its eyes for some time on an insect, it discharged from its mouth a small quantity of watery fluid, with such force and precision of aim, as to force it off the twig into the water, and in an instant swallowed it.

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* It is a mistaken notion that the pulmonary arteries in the toad and frog are derived from the aorta. When given off from the heart, and a little above it, the pulmonary arteries are closely attached to the aorta, so as not to be distinguishable till they quit their juxtaposition; and hence probably the error in question originated.

After this another fish came and performed a similar feat, and was followed by the others, till they had secured all the insects. I observed, that, if a fish failed in bringing down its prey at the first shot, that it swam round the pond, till it came opposite to the same object, and fired again. In one instance I observed one of these animals return three times to the attack before it secured its prey; but, in general, they seemed to be expert gunners, bringing down their prey at the first shot.

I was informed that these fish were originally imported from China, and are now the only specimens alive in Java, although, about fifty years ago, they were in possession of several of the Javanese chiefs. I could not learn their proper name; the only one that I heard was the usual term for fish made use of by the Javanese, viz. 'Icon.'

From the view we had of them, which was only in the water, they appeared short, about five or six inches in length, rather flat in the body, with blackish stripes variously interspersed.

The slaves of this chief fed the fish with insects regularly twice a day in the manner I have described.

This appears to me a novel species of instinct implanted into these animals by the wise Author of Nature, enabling them to secure their prey, by shooting in this manner those insects that should happen to rest on any of the aquatic plants growing in the ponds they inhabit, and placed by their height out of their reach.

When they eject the water from their mouths, it is attended by a noise like one spitting or squirting with a syringe.

As I had no opportunity of examining these fish, I could not say whether the fluid they squirted from their mouths was the product of secretion, or merely the water from the pond *.

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* The first account of this fish was published in the Transactions of the Royal Society of London, vol. liv. p. 89. It is contained in a letter to Mr P. Collins, F. R. S. from J. A. Schlosser, M. D. F. R. S. The following is an

On the Spontaneous Combustion of the Human Body.

On the 12th May 1828, M. Julia Fontenelle read, in the academy of sciences at Paris, a memoir entitled, *Recherches Chimiques et Medicales sur les Combustions Humaines Spontanées.*

The observations which form the subject of this memoir are highly deserving of attention. In fact, besides the interest

extract from the letter: "Governor Hommell * gives the following account of the jaculator or shooting-fish, a name alluding to its nature. It frequents the shores and sides of the sea and rivers in search of food. When it spies a fly sitting on the plants that grow in shallow water, it swims on to the distance of four, five, or six feet, and then, with a surprising dexterity, it ejects out of its tubular mouth a single drop of water, which never fails striking the fly into the sea, where it soon becomes its prey.

"The relation of this uncommon action of this cunning fish raised the governor's curiosity; though it came well attested, yet he was determined, if possible, to be convinced of the truth, by ocular demonstration.

"For that purpose, he ordered a large wide tun to be filled with sea-water; then had some of these fish caught, and put into it, which was changed every other day. In a while they seemed reconciled to their confinement; then he determined to try the experiment.

"A slender stick, with a fly pinned on at its end, was placed in such a direction, on the side of the vessel, as the fish should strike it.

"It was with inexpressible delight that he daily saw these fish exercising their skill in shooting at the fly with an amazing velocity, and never missed the mark."

Then follows Linnæus's description, taken from his work of the Museum of the King of Sweden, printed in 1754, where it bears the name of *Chætodon rostratum.*

In vol. lvi. p. 186, there is a farther account of the habits of this fish, in a letter from Mr Hommel: "When the jaculator fish," he says, "intends to catch a fly, or any other insect, which is seen at a distance, it approaches very slowly and cautiously, and comes, as much as possible, perpendicularly under the object: then, the body being put in an oblique position, and the mouth and eyes being near the surface of the water, the jaculator stays a moment quite immoveable, having its eyes directly fixed on the insect, and then begins to shoot, without ever shewing its mouth above the surface of the water, out of which the single drop, shot at the object, seems to rise. No more than two different species of this fish are found here." The first is that already mentioned, as described by Linnæus under the name Chætodon rostratum, and to which all the above refers. The other is described by Dr Pallas, under the name of *Sciæna jaculatrix*, p. 187 of the same volume. Both species are figured.—Editor.

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* Mr Hommel, Governor of the Hospital at Batavia.

which they are capable of exciting from their very nature, they afford a new example of one of those phenomena, the existence of which has, in these later times, been questioned, solely because, while they are very singular and difficult to be accounted for, they are also of such rare occurrence, that they can only be authenticated by an aggregate mass of evidence, which evidence, although sufficient to induce conviction, may always be rejected by those who are prejudiced, or who do not give themselves the trouble of duly estimating their value.

Are there really spontaneous combustions of the human body? Such is the first question which the author examines, and he resolves it by the affirmative. Fifteen observations of spontaneous combustions, which he successively relates, enable him not only to establish the incontestible reality of the phenomenon, but also to make known the principal circumstances which accompany its manifestation. In summing up these circumstances, he remarks:

1. That persons, who have been destroyed by spontaneous combustion, have, for the most part, been immoderately addicted to the use of spirituous liquors.

2. That this combustion is almost always general, but that it may be only partial.

3. That it is much rarer in men than in women, and that the women in which it has been manifested, have almost all been aged; one woman only was seventeen years of age, and in her the combustion was but partial.

4. That the body and viscera have always been burnt, while the feet, the hands, and the top of the head, have almost always escaped.

5. Although it is demonstrated that several loads of wood are necessary for reducing a dead body to ashes by ordinary combustion, incineration is effected in spontaneous combustions without the most combustible objects placed in the vicinity being burnt. In one case there was a very singular coincidence of two persons being consumed at the same time, in the same apartment, without the apartment or the furniture being burnt.

6. It is not demonstrated that the presence of a burning body is necessary for producing spontaneous combustion of the human body; on the contrary there is every reason to believe the reverse.

7. Water, so far from extinguishing the flame, seems to render it more active; and after the flame has disappeared, the intimate combustion continues to be effected.

8. Spontaneous combustions have appeared more frequently in winter than in summer.

9. No remedy has been found for general combustion, but only for partial.

10. Those who undergo spontaneous combustion, are the prey of a violent internal heat.

11. Spontaneous combustion developes itself suddenly, and consumes the body in a few hours.

12. The parts of the body which are not consumed by it, are attacked with sphacelus.

13. In individuals affected by spontaneous combustion, there supervenes a putrid deterioration, which presently brings on gangrene.

14. The residuum of spontaneous combustion consists of greasy ashes, and an unctuous soot, both having a fetid odour, which diffuses itself equally through the apartment, impregnating the furniture, and extending to a great distance.

The author then explains the two theories of combustion between which the learned world is at present divided; Lavoisier's, and that lately proposed by Berzelius. He then gives an account of the theories proposed for the explanation of the phenomenon in question.

Most authors, who have spoken of spontaneous combustions, have imagined they discovered an intimate relation between their manifestation and the immoderate use of spirituous liquors in the individuals attacked. They suppose that these liquors, being continually in contact with the stomach, penetrate through the tissues, and fill them up to saturation, in such a manner that the approach of a burning body is sufficient to induce combustion in them.

M. Julia Fontenelle does not consider this explanation satisfactory. He founds his opinion, 1st, On the circumstance that there is no proof of this alleged saturation of the organs in persons addicted to the use of spirits; 2dly, On the circumstance that this saturation itself would not suffice to render the body combustible,—and, to demonstrate this assertion, he gives the result of several experiments, in which he in vain tried to render ox-flesh inflammable by steeping it for several months in brandy, and even in alcohol and ether.

Another explanation has been proposed. Dr Marc, and with him several other physicians, from the development of hydrogen gas which takes place in greater or less quantity in the intestines, have been led to imagine that a similar development may take place in other parts of the body, and that the gas might take fire on the approach of a burning body, or by an electrical action produced by the electric fluid, which might be developed in the individuals thus burnt. According to this theory, MM. Lecat, Kopp, and Marc, suppose, in subjects affected by spontaneous combustion, 1. An idio-electric state; 2. The development of hydrogen gas; 3. Its accumulation in the cellular tissue.

This latter explanation would appear to be confirmed by a very curious observation of M. Bailly's. That physician, on opening, in the presence of twenty pupils, a dead body, over the whole of which there was an emphysema, which was greater in the lower extremities than any where else, remarked, that, whenever a longitudinal incision was made, a gas escaped, which burned with a blue flame. The puncture of the abdomen yielded a stream of it more than six inches high. What was very remarkable, was, that the gases contained in the intestines, so far from increasing the flame, extinguished it.

M. Julia Fontenelle, for reasons similar to those which induced him to reject the first hypothesis, is of opinion that the presence of hydrogen gas cannot be admitted as the cause of spontaneous combustion. He founds this opinion more particularly upon experiments in which he in vain tried to render very thin slices of flesh combustible, by keeping them for three days immersed in pure hydrogen gas, in percarburetted hydrogen gas, and in oxygen gas.

Lastly, He considers the opinion equally untenable, that spontaneous combustion of the human body is owing to a combination of animal matter with the oxygen of the air, whatever may be the alterations which this matter may undergo: 1. Because a sufficient temperature is not developed; 2. Because, admitting this combustion as real, the residuum would be a charcoal, which could only be incinerated at a red heat, while, on the contrary, there is nothing but ashes; 3. Because one of the products of spontaneous combustion of the human body is an unctuous substance, which the combustion of animal substances never yields; 4. Because it scarcely yields any ammoniacal products, while such are always produced by animal combustion.

After thus rejecting all the hypotheses hitherto proposed, M. Julia Fontenelle concludes that this phenomenon is the result of an internal decomposition, and is altogether independent of the influence of external agents. We give his own words.

"We consider," says he, "what are called spontaneous combustions of the human body, not as true combustions, but as intimate and spontaneous reactions, which depend upon new products originating from a degeneration of the muscles, tendons, viscera, &c. These products, on uniting, present the same phenomena as combustion, without losing any of the influence of external agents, whether by admitting the effect of the opposite electricities of Berzelius, or by adducing in example the inflammation of hydrogen, by its contact with chlorine, arsenic, or pulverized antimony, projected into this latter gas, &c.

It may be objected, however, that whatever may be the cause which induces this combustion, the caloric disengaged ought to be considerable, and consequently should ignite all the objects in the neighbourhood. We reply to this, that all combustible substances do not by any means disengage an equal quantity of caloric by combustion. Davy has shewn, that a metallic gauze, having 160 holes in the square inch, and made of wire one-sixtieth of an inch in diameter, is penetrated at the ordinary temperature by the flame of hydrogen gas, while it is impermeable to that of alcohol, unless the gauze be very much heated. According to the same chemist, gauze of this kind, raised to a red heat, allows the flame of hydrogen gas to pass through it, without being permeable to percarburetted hydrogen gas. It is probable from this, that the products arising from the degeneration of the body, may be very combustible, without, however, disengaging as much caloric as the other combustible bodies known, and without leaving a residuum as the two latter gases; and, in fine, we are of opinion, that, in some subjects, and chiefly in women, there exists a particular diathesis, which, conjoined with the asthenia occasioned by age, a life of little activity, and the abuse of spirituous liquors, may give rise to a spontaneous combustion. But we are far from considering as the material cause of this combustion, either alcohol, or hydrogen, or a superabundance of fat. If alcohol plays a prominent part in this combustion, it is by contributing to its production; that is to say, it produces, along with the other causes mentioned, the degeneration of which we have spoken, which gives rise to new products of a highly combustible nature, the reaction of which determines the combustion of the body.

It is to be regretted that the observations hitherto published are not more complete. We propose to ourselves to collect all that may tend to throw light upon a subject so important in anthropology and medical jurisprudence.

Description of several New or Rare Plants which have flowered in the neighbourhood of Edinburgh, and chiefly in the Royal Botanic Garden, during the last three months. By Dr Graham.

10*th June* 1828.

Begonia dipetala.

B. *dipetala*; fruticosa, erecta; foliis semicordatis, acutis, subangulatis, duplicato serrato-dentatis, supra glabriusculis maculatis, infra sanguineis ad venas subhirsutis; stipulis semicordatis, subpellucidis, mucronulatis, integerrimis; floribus dipetalis, fœmineis inæqualibus, capsulæ alis subæqualibus, rotundatis.

Description.—*Stem* erect, tapering, greyish-brown, with a few small round vermilion spots, scarcely branched in our specimens, which are small. *Leaves* half heart-shaped, acute, somewhat lobed, without any callosity on the edge, unequally and doubly serrato-dentate, slightly bullate, crisped at the edge when young, above green, with white spots, and having a pellucid short awl-shaped hair rising from the centre of a few of the spots, below blood coloured, but when old blanched, smooth, except at the veins, where there are a few hairs; veins prominent, especially below; petioles distichous, at first suberect, afterwards spreading or divaricated, nearly as long as the leaves, round, flattened a little and slightly channelled above. *Cyme* axillary, peduncled, drooping, rather longer than the petioles and leaves, dichotomous, peduncles and pedicels flattened, two obsolete nearly opposite *bracteæ* in the middle of the female pedicel, none on the male. *Flowers* pink, dipetalous, handsome, large (female 1 inch broad by ¾ inch long, male ¾ inch in either diameter); males in the clefts of the cyme, and on the outside of its subdivisions; those in the clefts expand first, the others nearly at the same time with the corresponding females. *Petals* in the males subrotund, in the females more cordate, in both, but especially the latter, subacuminate. *Stamens* numerous, filaments wedge-shaped at the top, an anther cell being fixed along each side. *Capsule*, wings rounded, subequal. *Stigmas* pale yellow, revolute, angled, pubescent along the edge.

This species flowered at the Royal Botanic Garden, Edinburgh, in April 1828, having been raised in 1826 from seed sent by Dr Johnston from Bombay. Like all the other species, it requires the heat of the stove.

Begonia papillosa.

B. *papillosa;* caule rotundato, erecto; foliis inæqualiter cordatis, acuminatis, inæqualiter dentato-ciliatis, supra albo maculatis, papillisque acuminatis raris, infra ad venas pubescentibus; stipulis ovatis, acuminatis, integerrimis; capsulæ alis subæqualibus, obtusangulis.

DESCRIPTION.—*Stem* erect, 14 inches high, scarcely branched in our specimens till after being cut down, but probably more when in a vigorous state, somewhat tumid at the joints, round, brown. *Petioles* alternate, spreading, round, channelled above, pubescent, 1¼ inch long. *Leaves* three and a half times as long as the petiole, very unequally cordate, acuminate, somewhat undulate and bullate, crisped, on the upper surface bright green and shining, occasionally spotted with white, and having distant papillæ, of which each is terminated with a curved, rather harsh hair, red and glabrous below, except at the veins, which are sparingly pubescent, unequally tooth-ciliated, and somewhat angled. *Stipulæ* ovate, acuminate, smooth, entire, marcescent. *Cymes* axillary, longer than the leaves, turned to one side of the stem, drooping, (thrice?) dichotomous, peduncles and pedicels flattened. *Bracteæ* opposite, ovate, coloured, deciduous, placed in pairs at each division of the cyme, and at the base of each female flower, but awanting in the males. Male flowers placed in the angle of the bifurcations, and, as it would appear, always along with a female at the ultimate divisions of the cyme, where they hang on the outside of the female flowers in the two lateral, and on the inside in the two middle divisions of the cyme, each always expands before the corresponding female flower; this distribution and premature evolution of the male flowers are common in the genus. *Corolla* tetrapetalous, very unequal, large, rather more so in the female flowers, where the external petals are retuse, fully three quarters of an inch broad by half an inch long; in the male cordato-subrotund. *Stamens* numerous; filaments slender; anthers large, wedge-shaped. *Pistils* yellow, somewhat spreading; styles channelled, enlarging upwards; stigmata large, lobed, revolute, crisped and pubescent; germen nearly equally winged, angles blunt, and upper edges at right angles to the axis of the flower.

This species flowered in the stove of the Royal Botanic Garden, Edinburgh, in April this season, and about the same time in the three last years. We received the plant from Kew in 1824, but without specific name, or an intimation regarding its native country.

Cattleya intermedia.

C. *intermedia;* perianthio subæquali, subacuto; lobello trilobo, lobo medio cordato rotundato; spatha obtusa, subherbacea, lata, compressa, pedunculum subæquanti; caule articulato, clavato, vix bulboso, compresso.

DESCRIPTION.—*Plant* parasitical. *Root* of strong, cylindrical, branching, fibres, green where exposed. *Stems* numerous, jointed, 3–9 inches high, enlarging upwards, but scarcely bulbous, smooth when in vigour, but often deeply furrowed, covered with grey, withered, blunt, adpressed sheaths, green where exposed, terminated by two leaves. *Leaves* 5 inches long, sub-opposite, nearly equal, spreading, flat, ovato-ligulate, fleshy, nerveless, very slightly notched, and mucronate at the apex, yellowish-green when young, afterwards darker. *Spathe* submembranous, blunt, compressed, broad, green, united at its edges, open only at its extremity, 2 inches long. *Peduncle* scarcely exserted, round, smooth, supporting at its apex one flower in our specimens, but as there is also an abortive bud, it seems probable that the natural inflorescence is 2-flowered. *Perianth* nearly equal, of uniform, delicate, faint lilac colour, inodorous; upper segment 2¼ inches long, linear-elliptical, reflexed on the edges, and terminated by a greenish point, the four others 2 inches long, falcate, undulate, and more nearly lanceolate, the two inner rather the narrowest. *Labellum* as long as the perianth, and of rather paler colour, having many erect papillæ within the edges of the column, curved downwards, flattened, its edges entire, and overlapping above, terminated by three lobes, of which the middle is the largest, projecting forwards, cordato-subrotund, saddle-shaped, all the three ragged at the edge, and undulated, but the lateral lobes less so, and not spreading; middle lobe of deep purple, mottled with the general colour of the labellum or perianth. *Column* half the length of the labellum, shaped like a boat, blunt in the keel, and inverted upon the floor of the labellum, a round notch at its extremity, with a projecting tooth in the middle bent over the anther-case; the sides of this notch project, are truncated, and edged with purple; general colour of the column the same as the upper part of the labellum, but beautifully streaked with purple, especially on its lower side. *Anther-case* attached at the base of the terminal tooth of the column, large, nearly white, bilobular, hemispherical, flattened on both its sides, applied by its lower surface to the top of the stigma, each lobe bilocular, loculaments linear, open towards the stigma, and having brown, dry, crisped, somewhat ragged edges: *Pollen-masses* 4, in pairs, dry, hard, obscurely granular, yellow, ovate, subacute, flattened, each convex on the side next its fellow, attached by one side of its base to a flattened yellow filament, the point of articulation being brown. These filaments cohere slightly in pairs by their edges, are inflected, and passing between the pollen-masses and the stigma, become again inflected at their terminations, in four distinct points, at the origin of the anther-case. *Stigma* large, occupying nearly the upper half of the lower side of the column, flat, and projecting along the lower surface of the anther-case, concave below, and subacute downwards. *Germen* about 1¼ inch long, club-shaped, erect, slightly curved, brownish-green, slightly spotted with purple, and having three longitudinal double furrows.

It is with much pleasure that I add a fifth species of *Cattleya* to the four already in cultivation. Its nearest affinity certainly is to *C. Forbesii*, but the general appearance of the flower more nearly resembles *C. labiata*, and it is almost as handsome. *C. Forbesii* could not be distinguished from this by the essential character given by Lindley in Bot. Reg. fol. 953., to which, therefore, must be added the acuminate membranous spathe, closely embracing the peduncle, and much shorter than it. The habit, as shown in Bot. Reg. is precisely the same as *C. intermedia*.

C. intermedia has the 3-lobed lip and the stem of *C. Loddigesii* and *C. Forbesii*, the approximating perianth of *C. Forbesii* and *C. labiata*, the form of perianth and sharply jagged lip of *C. Forbesii*, the colours and spathe of *C. labiata*, only that the spathe is united at its edges, in which circumstance there is an agreement with *C. Loddigesii*, but in this, again, the spathe is pointed, and much shorter than the peduncle.

We received our specimens, along with many other valuable plants, from Mr Harris of Rio Janeiro, by Captain Graham of his Majesty's Packet Service, in 1824. They have been kept in the stove in pots of decayed bark, and the specimen now described flowered for the first time in spring 1826, but met with an accident before it could be figured or described. It for the second time flowered last April, and remained in perfection several days. Another plant has blossomed while this sheet was at the press. Other specimens, subjected to precisely the same treatment, have remained without the least alteration in their appearance since they were imported. The subject of the present article is now pushing its roots freely over the pieces of bark. A figure taken from it will be given by Dr Hooker in an early number of the Botanical Magazine.

Conospermum ericifolium.

C. *ericifolium;* foliis lineare-filiformibus, utrinque subcanaliculatis, aveniis; pedunculis elongatis, spicis subcapitatis; calyce extus pubescenti, limbo tubum vix æquante.

Conospermum ericifolium, *Brown*, Trans. Lin. Soc. vol. x. p. 154.—*Rudge*, ibid. p. 292, t. 17, f. 1.

Description.—*Shrub* erect; *stem* round, brown; *branches* erect, green when young. *Leaves* linear, and very slender, slightly twisted, mucronate, obscurely channelled on both sides, veinless, slightly scabrous, imbricated, persisting, very numerous. *Peduncles* axillary, crowded at the extremities of the branches, erect, elongated, slightly scabrous, and having a few scattered, ovato-acuminate, bluish bracteæ, but no flowers except at the top, where they support a short spike. *Flowers* in the bud slightly tinged, purple, afterwards white, spreading, each sessile in the axil of a bractea, which is larger than those below. *Calyx* pubescent; tube curved outwards, and obscurely tetragonous, limb inflated, bilabiate; upper lip pointed, reflected; lower lip of three straight erect teeth of equal length, but the two outer are rather broader than that in the middle. *Stamens* 4, inserted into the throat of the calyx; filaments short, double, the two portions of that under the acute segment of the perianth, adhering to each other throughout their whole length, the other three cleft; anthers brown, cordate, that on the first filament bilocular, those at the sides unilocular, and adhering to one half of the filament only; there is no appearance of anther on either of the pointed terminations of the filament on the lower side of the calyx; pollen white. *Germen* obversely conical, silky, and crowned with a long tuft of unequal hairs; *ovules* few, green, pear-shaped, flattened; *style* passing out between the segments of the barren filaments, reaches beyond the stamens, enlarging upwards; *stigma* hooked.

Our plant was raised from seed sent by Mr Aiton from the Botanic Garden, Kew, in 1823, under the name of *C. erectum*, and has flowered in spring for several years. It is kept in the greenhouse, and remains a long while in flower. The leaves are longer, and less crowded than in Mr Rudge's figure, no doubt from our plant being more vigorous. The singular connection of the anthers in the bud, will be detailed by Dr Hooker in dissections accompanying a figure in the Botanical Magazine.

Draba gracilis.

D. *gracilis;* caule folioso, erecto, ramoso, pubescenti; foliis ovatis serratis, stellatim pilosis, pilis ramosis; pedunculo oppositifolio, ad basin piloso, supra cumque pedicellis et silicula oblonga glabro; calycibus pilosiusculis; pedicellis flore longioribus.

D. lutea, β longipes, *Richardson's* Botanical Appendix to Franklin's Narrative, 257.—*Decand.* System, vol. ii. p. 351?

Description.—Annual or biennial. *Stem* more or less leafy, branched, clothed with loose hairs; branches spreading, having pubescence like that on the stem. *Leaves* ovate (the root-leaves sometimes obovate), flat, serrated, veinless, but with a strong middle rib projecting behind, hispid with tufted, branched, spreading hairs. *Peduncles* slender, many-flowered, opposite to the leaves, erect, about three inches long when half the flowers have been expanded, slightly hairy as far as the lowest pedicel, above this smooth and shining, hairs simple or branched: *Pedicels* corymbose, crowded, erect, longer than the flowers, when in fruit spreading, straight, filiform, shining, elongated to more than half an inch, and loosely scattered over the lengthened peduncle. *Calyx* yellowish-green, cup-shaped, segments ovate concave, unequal, and having a few long, spreading, branched or simple hairs. *Corolla* minute, but longer than the calyx, yellow; petals unguiculate, linear-obcordate, spreading in the upper half, obscurely veined. Longer *stamens* projecting a little way above the plain of the spreading part of the petals, the shorter, scarcely as much below it; *anthers* bilobular, yellow; *filaments* pale. *Germen* green, ovate; *style* very short; *stigma* large, and reaching to the anthers of the long stamens. *Silicle* naked, a little irregular on its surface. *Seeds* numerous.

Seeds of this plant were received from Dr Richardson in November 1827, along with an extensive collection made by Mr Drummond and him in the expedition to the northern coast of America, from which they had just returned. It was raised under a cold frame in the Royal Botanic

Garden, Edinburgh, and flowered in May. I understand from Mr Drummond that it is exceedingly common all over the district the expedition visited. Comparison with a specimen in the collection sent to Professor Jameson by Dr Richardson, after his first expedition, leaves no doubt about this being the plant mentioned by him; but I question the correctness of the synonyme from De Candolle, which Dr Richardson quotes with doubt. This I should think distinguished, among other marks, by its oval, subacute leaves, and by the petals being nearly elliptical.

Eriostemon salicifolius.

E. *salicifolius;* frutex foliis sparsis lineare-oblongis subfalcatis, coriaceis, scabris, aveniis, apice callosis muticis, nervo intermedio obsoleto; floribus axillaribus, solitariis, pallidis, antheris glabris, filamentis ciliatis.

Description.—*Shrub* erect. *Stem* nearly round. *Branches* little angular. *Leaves* scattered and adpressed, linear-oblong, somewhat falcate, coriaceous, quite entire, rather hollow in front, rough, veinless, middle rib obscurely marked behind, awanting in front. *Flowers* axillary, solitary, pale lilac, on short, scaly pedicels. *Calyx* yellowish-white, ciliated. *Petals* ovato-oblong. *Stamens* erect; *filaments* reaching to the top of the style, strongly ciliated: *anthers* cordate, smooth, appendage small, white, recurved, naked; *pollen* orange. *Germen* of five foliculi, united to each other below the middle. *Style* single, dipping down between the apices of the lobes of the germen.

The rough leaves and scarcely angular stems of this plant would have made me consider it as specifically distinct from *Eriostemon salicifolius* of Smith (*Crowea saligna* of Sieber, not of Smith), had it not been for its identity with what Dr Hooker believes to be authentic specimens of this in his herbarium. It was raised at the Royal Botanic Garden, Edinburgh, from seed sent from New Holland by Mr Fraser in 1823, under the generic name of *Crowea.* It has flowered in April last year and this, has received the ordinary treatment of New Holland plants, and does not seem of free growth.

Hedysarum nutans.

H. *nutans;* frutex ramosus, racemis compositis, terminalibus axillaribusque, ramisque pendulis, floribus geminatis; bracteis acutis; foliis ternatis, pendulis, foliolis rhomboideis, integerrimis, utrinque tomentosis, stipulis subulatis.

Description.—With us a low slender *shrub,* much branched; branches long, straggling, drooping; bark brown, much cracked, desquamating. *Leaves* scattered, ternate, leafets rotundato-rhomboidal, undulate, mucronulate, reticulate, soft with dense short tomentum on both sides, the terminal one twice the size of the others, (three inches in either diameter,) and on a petiol half its own length, the lateral ones just above the middle of the common petiol, on short partial petiols; common petiol from its base to the terminal leafet fully three inches long, slightly channelled above. *Stipulæ* lateral, subulate. *Racemes* a foot long, terminal or axillary, branched. *Flowers* in pairs, on pedicels nearly as long as themselves, the panicle branching from between them, but many of the branches shewing no more than their terminal flower-bud. *Calyx* 4-cleft, opposite segments equal, ovate, subacute, concave, spreading, and on the outside, as well as the peduncle and pedicels, hairy. *Corolla* of uniform delicate lilac, gaping; vexillum erect, flattish, subrhomboid, notched, faintly striated, and marked in the middle with a deeper purple spot, the lower part of which is green; unguis inversely conical; alæ depressed, about as long as the vexillum, and nearly forming a right angle with it, lower edges in contact in the anterior half, open behind, abruptly cut down to narrow, flattened, linear claws, which are continuous with their lower edges; keel rather paler than the rest of the flower, and somewhat more distinctly striated, shorter than the alæ, notched at its apex, and split from the base to nearly half its length, having two linear claws, above which it is gibbous on both sides, and adheres there to corresponding depressions of the alæ. It shuts the opening between the claws of these, so as with them to give the form of a boat to the lower half of the flower. *Stamens* monadelphous, straight, being scarcely curved at their apices; anthers yellow. *Germen* long, linear, slightly hairy, indistinctly lobed; *style* bent at right angles to the germen, conical, smooth; *stigma* terminal, small, cleft, in contact with the vexillum.

This plant was brought to the Royal Botanic Garden, Edinburgh, in 1823, under the name here adopted, from the Botanic Garden, Calcutta, by Dr Macwhirter, and has flowered in the stove every summer since. Were it not that its flowers drop very early, so that a few only are expanded at a time, it would be very ornamental, as the raceme is large, the colour of the flowers beautiful, and the drooping branches graceful. It has never formed fruit.

Iris lutescens.

I. *lutescens;* caule simplici unifloro folioso, folium inferius æquanti; flore barbato, breve pedunculato, tubo corollæ germen superanti, laciniis undulatis, crenulatis, obtusis, unguiculatis, interioribus latioribus inflexis, laciniis labii superioris stigmatis acutis, spatha erecta, excedente et valvula interiora vix inflata involvente tubum.

I. lutescens, *Willd.* Sp. Pl. vol. i. p. 225.—Hort. Kew. ed. 2. vol. i. p. 118. *Lamarck*, Tableau Encyclop. vol. i. p. 122.—Ibid. Encyclop. Method. vol. iii. p. 297.

Description.—*Stem* leafy, flexuose, about seven inches high, nearly round, one-flowered. *Leaves* scymitar-shaped, and a little turned forward at the point, partially glaucous or subpruinose, ribbed, the lowest equal in length to the stem, the others shorter, sheathing the stem, sheaths compressed and bordered. *Spathe* bivalvular, longer than the tube of the corolla; valves pointed, herbaceous, green, membranous and withered towards their apices; outer valve rather the broadest, but scarcely longer than the other, erect, the inner sheathing the tube of the corolla, and slightly inflated. *Peduncle* about three-eighths of an inch long, nearly round, succulent, and nearly colourless; by its side within the spathe there is a small awl-shaped thread, the abortive representation of a second peduncle. *Corolla* pale yellow, delicate, nearly the whole of the outer segments, and the claws of the inner, streaked with pale brown; segments undulate, crenulate, especially towards their extremities, nearly of equal length; outer rolled backwards, bearded with yellow hairs, spathulate, tapering gradually towards their base; inner the broadest, bent across the centre of the flower above the stigmata, oblong, and decurrent upon long winged claws, which are more slender than those of the outer segments. All the segments when decaying have their claws adpressed to the style, and their laminæ folded across the centre of the flower, so as entirely to close it. Tube above 1 inch long, limb including the claws about 2¼ inches. *Stamens* shorter than the stigmata; filaments subulate, adhering to the corolla as high as the base of the hairy line; anthers white, equal in length to the free portion of the filaments. *Stigmata* broader than the portion of the reflected segments of the corolla which they cover, about 1¼ inch long, upper lip erect, its segments pointed, inciso-serrated. *Style* 3-sided, free for nearly half an inch, below which it is united to the tube of the corolla. *Germen* half an inch long, green, trigonous, marked along the middle of each side by a slightly prominent line opposite to the insertion of the dissepiments. *Ovules* obovate, attached to the central column.

This is certainly the *Iris lutescens* of the authorities quoted above, though Steudel (Nomenclator Botanicus) says it is not that of Lamarck, and he refers the *I. lutescens* of Willd. and Hort. Kew. to *I. virescens* of Decand. which again Sprengel considers *I. variegata;* but this species, as figured in Bot. Mag. t. 16. is held distinct from our plant, by its many-flowered stem, and by the appearance of its spathe. The *I. lutescens* of Sprengel, erroneously attributed to Lamarck, is quite different from our plant, and is at once distinguished by the obtuse upper lip of its stigma, and by its short stem. It is probably one of the modifications of *Iris pumila*, var. *lutea*, Bot. Mag. t. 1209.

The subject of the present article was given to us by David Falconar, Esq. in whose garden at Carlowrie, near Edinburgh, (distinguished especially for being rich in this genus) it flowered in May 1828; and a second specimen was sent by him from the garden of Messrs Dickson and Co. seedsmen, Edinburgh. A figure from this last will appear in the Botanical Magazine. According to Lamarck it is a native of hilly, stony places, in France and Germany.

Nicotiana glauca.

N. *glauca;* caule suffruticoso erecto ramoso; foliis inæqualiter cordato-ovatis, acutis, obsolete sinuatis, nudis, glaucis, longe petiolatis; floribus paniculatis, terminalibus; calyce quinque dentato; corollæ limbo regulari, laciniis acutis, brevissimis.

Description.—Plant probably short-lived. *Stem* erect, round, branched, of great height—native specimens said to be 20 feet high—ours above ten, and still growing freely. *Branches* ascending obliquely. *Leaves* petioled, somewhat unequal at the base, cordato-ovate, obscurely sinuate, acuminate, smooth, soft, naked, veined (5 inches long, 3 broad), middle rib strong; *petiole* round, spreading, shorter than the leaf (3 inches long). *Panicle* terminal, secund, lax; pedicels rising from the axils of minute subulate bracteæ, which, however, are often awanting. *Calyx* persisting, as long as the pedicel, tubular, obscurely angled, with five sharp, unequal, erect, ciliated teeth. *Corolla* green in bud, afterwards of uniform yellow colour, covered with close, white, soft pubescence on the outside; tube slightly curved downwards, thrice as long as the calyx, within which it is contracted, and five-furrowed, beyond this five-sided, and of nearly uniform diameter, till near the faux, where it is slightly inflated, and again contracted immediately below the limb; limb small, cup-shaped, segments short, acute, erect. *Stamens* unequal; filaments slender, incurved from the sides of the corolla at their apices, also approaching each other above their insertion into the corolla at the extremity of the calyx, below this adhering to the inside of the tube, in the structure of which they are lost downwards; anthers short, oblong, pendulous, bilobular, lobes unconnected at their apices, green before bursting, immediately afterwards reflected and brown, on the longer filaments subexserted; pollen light yellow. *Stigma* dark green, subexserted bifid, segments short, spreading; *style* filiform, somewhat compressed; *germen* ovate, bilocular; *ovula* very numerous, oblong, crowded along a large columnar receptacle. Whole plant to the base of the pedicels of beautiful glaucous hue, and pruinose; at this point, at the base of the petioles, and on the young leaves, by the sides of the middle rib near the petiole, the colour is dark purple. The bloom is easily rubbed from every part but the leaves (where it is more fixed), leaving the cuticle of lively green, as on the pedicels and calyx, where the bloom is awanting. Whole plant inodorous. In the arrangement of the species this should follow *N. cerinthoides.*

The plant was raised in 1827 from seeds communicated without specific name, to the Royal Botanic Garden, Edinburgh, by Mr Smith at Monkwood, whose son sent them from Buenos Ayres. It was kept in the stove, but, on coming into flower in the middle of March last, was removed to the greenhouse. It will bear flowers for several weeks yet to come. A small plant still in the stove is ripening its seeds there.

Polygala paucifolia.

P. *paucifolia;* caulibus simplicibus erectis, inferne squamis vice foliorum; foliis alternis petiolatis ovatis; floribus hexandris subternis, subterminalibus, cristatis.

P. paucifolia, *Willd.* vol. iii. p. 880.—*Persoon,* vol. ii. p. 272.—*Decand.* Prodr. Reg. Veget. pars i. p. 331.—*Pursh,* vol. ii. p. 464.—*Nuttall,* vol. ii. p. 87.—*Bigelow,* Flora Bostoniensis, p. 267.—*Elliott's* Botany of South Carolina and Georgia, vol. ii. p. 180.

Triclisperma grandiflora, *Rafinesque,* Specch. i. p. 117.

DESCRIPTION.—*Root* slender, creeping near the surface, perennial. *Stem* herbaceous, erect, angular, shining, 3 or 4 inches high. *Leaves* collected near the top, petioled, ovate, acute at both ends, shining, nearly naked, imperfectly ciliated, sparingly veined, green, red when young, in the lower part of the stem degenerating into ovate, pointed, sessile scales. *Peduncle* generally terminal, though in a few instances the stem is extended beyond it, when it is opposite to the leaf, 1, 2, or 3-flowered, very short; pedicels loose, half as long as the flowers, angular, red, naked, and shining. *Calyx*, two lowest segments small, lanceolato-ovate, upper segment tumid, ovato-concave; wings spreading, obovate, as long as the wings of the corolla. *Corolla* handsome, three-fourths of an inch long, nectariferous at the base: petals 3, coalescing below for above half of their length, compressed, wings overlapping above, slightly arched towards their apices; keel, after separating from the wings, inflated, rounded, edges in contact above, terminated by a purple-tipped beard, forming a tuft nearly as large as the inflated portion of the keel: whole flower of beautiful purple, indistinctly veined, pale, almost white, on its lower side. *Stamens* six; filaments united to the inside of the petals at the point where these separate from each other, after which they project forwards in two equal opposite bundles, smooth, flattened, colourless; anthers terminal, obscurely bilobed, yellow. *Stigma* truncated, obscurely bordered, bilabiate, lips diverging, the upper largest and pointed; *style* clavate, bent, colourless towards the stigma, purple below; *germen* unequally obcordate, green, compressed.

Nuttall quotes, though with doubt, the *P. uniflora* of Michaux as a synonyme of this species, but as it is beardless, which no imperfect specimen even of this ever is, and as the inflorescence is quite different, they certainly are distinct, though *P. paucifolia* has often one flower only. The species is altogether overlooked by Michaux. De Candolle, in his Prodromus, and Don, in Hortus Cantabrigiensis, 8th edit. quote as a synonyme for *P. paucifolia*, *P. purpurea* of Hortus Kewensis.

Mr Lindley, in the 10th edition of Hort. Cantab. considers these distinct; and if there is no mistake in *P. purpurea* being called a shrub in Hort. Kew. they must be so, but by others it is described as herbaceous. This doubt can only be removed by a reference to the specimen, which probably exists in the Banksian herbarium. Our plant is altogether different from *P. purpurea* of Nuttall, which is *P. sanguinea* of Michaux and Pursh.

This beautiful plant flowered sparingly last year in the nursery-garden of Mr Cunninghame, at Comely Bank near Edinburgh, having been introduced from Canada by Mr Blair. During the month of May 1828 it has flowered abundantly, and formed one of the pleasing objects in Mr Cunninghame's extensive collection. It has spread itself widely among loose vegetable soil, in a cold frame, under the shade of the garden-wall.

Celestial Phenomena from July 1. *to October* 1. 1828, *calculated for the Meridian of Edinburgh, Mean Time.* By Mr GEORGE INNES, Aberdeen.

The times are inserted according to the Civil reckoning, the day beginning at midnight. —The Conjunctions of the Moon with the Stars are given in *Right Ascension*.

JULY.

D.	H.	′	″		D.	H.	′	″	
1.	2	9	2	☍ ☉ ♂	6.	6	0	8	☾ Last Quarter.
1.	7	25	10	☌ ☽ ϑ ♒	8.	7	56	59	☌ ☽ 1 ϑ ♉
4.	11	8	46	☌ ☽ ε ♓	8.	8	27	0	☌ ☽ 2 ϑ ♉
4.	15	32	7	☌ ☽ ζ ♓	8.	10	51	10	☌ ☽ ε ♉

JULY.

D.	H.	′	″		D.	H.	′	″	
12.	1	30	17	● New Moon.	20.	18	16	37	☌ ☽ ♃
12.	8	52	35	☌ ☽ ♄	21.	8	58	23	☌ ♂ λ ♐
13.	14	4	4	☌ ☽ ☿	22.	1	52	51	☌ ☽ 4 ζ ♎
13.	19	57	8	☌ ☽ 1 α ♋	22.	10	28	38	☌ ☽ δ ♎
13.	21	4	50	☌ ☽ 2 α ♋	22.	22	55	45	☉ enters ♌
13.	23	3	55	☌ ☽ ♀	23.	7	54	20	☍ ☉ ♅
14.	18	38	33	☌ ☽ ο ♌	24.	18	20	–	Inf. ☌ ☉ ☿
15.	4	51	37	☌ ☽ π ♌	24.	22	1	26	☌ ☽ ♂
16.	12	54	40	☌ ☉ ♄	26.	16	36	21	☌ ☽ ♅
16.	21	19	59	Em. I. sat. ♃	26.	18	53	22	☌ ☽ β ♑
17.	3	30	20	☌ ☽ ν ♌	26.	22	21	9	○ Full Moon.
17.	14	51	15	☌ ♀ 2 α ♋	28.	8	9	30	Inf. ☌ ☉ ♀
17.	21	58	51	Em. III. sat. ♃	28.	16	55	56	☌ ☽ δ ♒
18.	21	27	29	☌ ♀ 1 α ♋	31.	18	16	48	☌ ☽ ε ♓
20.	4	4	27	☽ First Quarter.	31.	22	32	53	☌ ☽ ζ ♓
20.	17	15	58	☌ ☽ λ ♍					

AUGUST.

D.	H.	′	″		D.	H.	′	″	
1.	12	36	56	☌ ☽ ο ♓	17.	11	53	5	☌ ♂ λ ♐
2.	15	40	3	☾ Last Quarter.	18.	9	14	51	☌ ☽ 4 ζ ♎
4.	13	37	15	☌ ☽ 1 ϑ ♉	18.	14	45	31	☽ First Quarter.
4.	14	8	9	☌ ☽ 2 ϑ ♉	18.	18	6	22	☌ ☽ δ ♎
4.	16	32	8	☌ ☽ ε ♉	21.	9	54	19	☌ ☽ ♂
6.	20	38	6	Im. III. sat. ♃	23.	1	32	32	☌ ☽ ♅
8.	21	57	7	☌ ☽ ♄	23.	5	25	39	☉ enters ♍
9.	1	15	42	☌ ☽ ☿	23.	5	31	50	☌ ☽ β ♑
9.	1	50	59	☌ ☽ ♀	24.	19	50	52	Em. I. sat. ♃
9.	12	2	6	☌ ☿ ♀	25.	3	43	15	☌ ☽ δ ♒
10.	1	53	51	☌ ☽ 1 α ♋	25.	5	25	15	○ Full Moon.
10.	3	0	36	☌ ☽ 2 α ♋	28.	3	30	18	☌ ☽ ε ♓
10.	16	43	6	● New Moon.	28.	7	39	0	☌ ☽ ζ ♓
12.				☿ greatest elong.	28.	21	17	43	☌ ☽ ο ♓
13.	14	15	57	☌ ☽ ν ♌	28.	22	36	26	☌ ☿ α ♌
13.	14	51	49	☌ ♀ ♄	31.	4	1	0	☌ ♀ ♄
16.	23	47	36	☌ ☽ λ ♍	31.	20	26	41	☌ ☽ 1 ϑ ♉
17.	2	46	55	☌ ☿ ϑ ♋	31.	20	57	1	☌ ☽ 2 ϑ ♉
17.	4	58	11	☌ ☽ ♃					

SEPTEMBER.

D.	H.	′	″		D.	H.	′	″	
1.	4	34	24	☾ Last Quarter.	6.	15	0	–	Sup. ☌ ☉ ☿
5.	10	40	45	☌ ☽ ♄	7.	1	35	15	☌ ♂ σ ♐
5.	14	51	11	☌ ☽ ♀	7.	6	46	47	☌ ☽ ο ♌
6.	8	7	41	☌ ☽ 1 α ♋	7.	17	56	16	☌ ☽ π ♌
6.	9	14	37	☌ ☽ 2 α ♋	7.	23	24	29	☌ ☿ σ ♌
6.	14	29	50	☌ ♂ 1 ν ♐	9.	8	26	7	● New Moon.

SEPTEMBER.

D.	H.	′	″	
9.	14	4	30	☌ ☽ ☿
12.	8	49	4	☌ ☿ β ♍
13.	5	16	30	☌ ☽ κ ♍
13.	7	18	49	☌ ♂ τ ♐
13.	18	52	35	☌ ☽ ♃
14.	14	58	2	☌ ☽ 4 ζ ♎
14.	23	57	8	☌ ☽ ϑ ♎
16.	23	16	34	☽ First Quarter.
17.	0	5	51	☌ ☿ η ♍
17.	12	47	40	☌ ♀ 1 α ♋
17.	13	41	39	☌ ♀ 2 α ♋
17.	15	35	39	☌ ♂ ψ ♐
18.	10	54	51	☌ ☽ ♂
19.	11	13	30	☌ ☽ ♅
19.	14	38	56	☌ ☽ β ♑
21.	14	1	7	☌ ☽ ϑ ♒
23.	1	59	35	☉ enters ♎
23.	14	0	7	○ Full Moon.
24.	13	58	1	☌ ☽ ι ♓
24.	18	3	27	☌ ☽ ζ ♓
25.	7	28	32	☌ ☽ ο ♓
27.	22	4	22	☌ ♀ ξ ♌
28.	4	56	19	☌ ☽ 1 δ ♉
28.	5	25	55	☌ ☽ 2 δ ♉
28.	6	1	41	☌ ♃ 2 α ♎
30.	20	52	44	☾ Last Quarter.

Times of the Planets passing the Meridian.

APRIL.

	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Georgian.
D.	H. ′	H. ′	H. ′	H. ′	H. ′	H. ′
1	13 37	14 9	23 48	19 19	12 44	1 25
5	13 28	13 55	23 27	19 2	12 32	1 9
10	13 12	13 32	23 1	18 43	12 14	0 49
15	12 48	13 7	22 36	18 24	12 0	0 28
20	12 17	12 38	22 9	18 5	11 40	0 7
25	11 34	12 6	21 47	17 49	11 23	23 48

MAY.

	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Georgian.
D.	H. ′	H. ′	H. ′	H. ′	H. ′	H. ′
1	11 2	11 20	21 17	17 22	10 58	23 14
5	10 46	10 56	21 3	17 8	10 46	22 58
10	10 37	10 28	20 44	16 50	10 29	22 37
15	10 38	10 4	20 27	16 33	10 11	22 17
20	10 50	9 44	20 12	16 15	9 54	21 56
25	11 14	9 27	19 57	15 58	9 37	21 35

JUNE.

	Mercury.	Venus.	Mars.	Jupiter.	Saturn.	Georgian.
D.	H. ′	H. ′	H. ′	H. ′	H. ′	H. ′
1	11 31	9 9	19 40	15 35	9 13	21 8
5	11 45	9 3	19 31	15 22	9 [illegible]	20 52
10	12 0	8 55	19 20	15 5	8 42	20 32
15	12 12	8 50	19 10	14 49	8 24	20 12
20	12 22	8 47	19 1	14 33	8 6	19 51
25	12 31	8 45	18 52	14 17	7 48	19 31

Proceedings of the Wernerian Natural History Society. Continued from former Volume, p. 398.

1828, *Feb.* 23.—ROBERT JAMESON, Esq. President, in the chair.—The Secretary read a notice regarding a living Ocelot, or Felis Pardalis, from South America, communicated by James Wilson, Esq. The animal was a female, nearly of full size; had been almost two years at Liverpool, and had lately been transferred to the menagerie of the Zoological Society in Regent's Park.

Dr R. E. Grant then read the second part of his account of the anatomy of the Perameles nasuta of New South Wales, treating particularly of the organs of generation.

March 8.—DAVID FALCONER, Esq. V. P. in the chair.—The Secretary read a notice of the wasting effects of the sea, which have exposed a submarine forest on the shores of Cheshire, between the rivers Mersey and Dee, by Robert Stevenson, Esq. civil engineer.

Mr G. A. W. Arnott read two memoirs: 1. On the Mines of the Higher Pyrenees; 2. On the Marbles of the Higher Pyrenees.—The Secretary read a communication from the Rev. John Macvicar, A. M. of St Andrew's, describing a rare fish, the Forked Hake of Pennant, which had been cast ashore near St Andrew's in a storm. A drawing of the fish, made by Mr Macvicar, was exhibited to the meeting.—Mr Deuchar, lecturer on chemistry, then read a notice of keeping entire the crystals of efflorescent and also of deliquescent salts, by means of surrounding them with an atmosphere, formed from an essential oil, such as oil of turpentine.

March 22.—DAVID FALCONAR, Esq. V. P. in the chair.—The Rev. Dr Scot of Corstorphine read a paper on the great fish that swallowed up Jonah, and, after three days and nights, cast him out on dry land; shewing that it could not be a whale, as often supposed, but was probably a Squalus Carcharias, or white shark.

At this meeting was also read the first part of a Memoir on the Lunar Compass, &c. by Mark Watt, Esq. (For an account of this interesting paper, see *supra*, p. 100. *et seq.*)

April 5.—**Patrick Small Keir**, Esq. formerly V. P. in the chair.—Mr Mark Watt read the remainder of his paper on the lunar compass. The Rev. Dr Scot read a memoir on the shefifon of Moses, Gen. xlix. 17, or the adder of the English translators; and the Secretary read a notice by Thomas Johnston, Esq. Hill Top, near Wetherby, of the great oak of Cowthorpe, in Yorkshire, illustrated by a drawing.

SCIENTIFIC INTELLIGENCE.

ASTRONOMY.

1. *On the Comet of* 1832, *which some predict is to destroy our Earth.*—Some German journals predict the appearance of a comet in 1832, which must destroy our globe, and this has been copied and commented on by the journalists of other countries. In a letter dated May 12. 1828, addressed to the French Academy of Sciences, the author, M. G***, a professor in Paris, ventures to put the question to the Academy, whether it does not consider itself bound in duty to refute as speedily as possible this ridiculous assertion. "Popular terrors," he observes, "are productive of serious consequences. Several members of the Academy may still remember the accidents and disorders which followed a similar threat, imprudently communicated to the Academie des Sciences, by M. de Lalande, in May 1773. Persons of weak minds died of fright, and women miscarried. There were not wanting people who knew too well the art of turning to their advantage the alarm inspired by the approaching comet, and *places in Paradise were sold at a very high rate.* The announcement of the comet of 1832 may produce similar effects, unless the authority of the Academy applies a prompt remedy, and this salutary intervention is at this moment implored by many benevolent persons. As it is extremely probable that the Academy will make no reply to this letter, we shall here enter into some details which will shew how destitute of foundation these popular errors are, which M. G * * * dreads. The comet which is to appear in 1832, is the comet of six years and three quarters, of which the orbit was calculated in France, by one of our most distinguished

astronomers, M. Damoiseau, member of the *Academie des Sciences*. All that has been said in Germany respecting this comet, is founded on the results obtained at Paris. Now, these results are so far from being terrifying, that they do not even leave the smallest possibility of an accident. The comet of 1832, in its shortest distance from the earth, will remain more than sixteen millions of leagues from it. It might come a thousand times nearer before any danger could be apprehended. In 1770, a comet came so near as 750,000 leagues (about nine times nearer than the moon). Lalande estimates the distance at which a comet might produce sensible effects on the earth, at 13,000 leagues. Whence, then, comes the error of the journalists, of whom the author of the letter speaks? Without doubt, solely from the circumstance, that the comet in question will pass very near the earth's orbit (at 4½ diameters, from 13000 to 14000 leagues); so that, in fact, were the earth to be at the time in the part of its orbit nearest the comet, some alarming disturbances might ensue. It is unnecessary to say that so gross a misapprehension as that which we have just pointed out, was not committed by any astronomer. The only respectable publication in Germany on the subject is a letter of *M. Olbers*, in which that astronomer gives an account of the results obtained by M. Damoiseau; and it is without doubt, because ignorant persons have seen in this letter that a comet will approach very near the earth's orbit in 1832, that they have persuaded themselves of its collision with the earth. M. G * * *'s letter contains an assertion with reference to Lalande, which we think it our duty to refute. That astronomer was but the very innocent cause of the general terror which pervaded the public mind in 1773. The following is the real case:—Newton, in speaking of the consequences that might result from a comet's coming in contact with the earth, had said that Providence had so arranged as to render such a collision impossible. Lalande thought differently. No orbit, it is true, was known that might interfere with that of the earth; but the orbits might be sensibly altered by the planetary attractions. Besides, the orbits of all the comets were very far from being known. Was it not rash to pronounce it certain, that none of the orbits hitherto not calculated, could come into contact with that of the earth, and that, of those known, none could ever be disarranged, so as to intersect it? There was nothing but what was very just in these remarks. Time has confirmed them, since the orbit of the comet of six years and three quarters passes so near that of the earth, that the smallest disturbance might cause their intersection. But before a disaster could happen, it would not only be necessary that the orbits should meet, but also that the bodies themselves should happen to be at the point of intersection, and the probabilities of such a concurrence are infinitely small. This was M. Lalande's opinion. He drew up a memoir on the subject for a public meeting of the Academy; but, happening to be last in the order of readers, the time passed away, and it was not read. The title *Reflexions sur les comètes qui peuvent approches de la terre*, announced a subject calculated to interest the greater number of hearers. It was asked, What the memoir contained? and the answer was, that it contained an account of the effects which a comet striking the earth might produce. A noise went abroad that the comet was to come, and that it was predicted by Lalande. Maupertuis, in his letters on the same subject, spoke in a much more positive and terrifying manner, and yet nobody took notice of them; but Maupertuis was not positively known as an astronomer; he had not made almanacks; he had not the power of inserting in the journals accounts of all the astronomical phenomena. The alarm excited by this alleged prediction was so general, that the lieutenant of police wished to see the memoir; he found nothing in it to authorise the terrors that had arisen, and ordered its speedy publication. When it was printed, nobody would believe it. It was pretended that the author had suppressed the fatal prediction, not to terrify by the announcement of a catastrophe from which he had no means of withdrawing himself. The same terrors were renewed at various epochs, but with less violence, and the blame was always laid upon Lalande, who had not said a single word on the subject. At the present day, comets are not so general an object of terror. In proportion as the mass of the population becomes more enlightened, superstitious terrors of all kinds are less to be dreaded. The conjunctions of the planets, which were formerly the cause of much more violent, and still more unreasonable fears; and eclipses, which so long divided with comets the right of terrifying the nations of the earth, have been discovered to be incapable of producing any of the effects that were attributed to them. Of all these terrors, there only remains, with respect to comets, a possibility so extremely uncertain, that no rational person could conceive any apprehension on the subject. One thing which we must not omit to mention, with respect to comets, is, that the new data obtained respecting their constitution, are of such a nature as to modify, in a great degree, the ideas suggested by the possible occurrence of accidents resulting from their striking against the earth. These bodies, in fact, which were supposed to have a density many thousands of times greater than the earth, are in general formed of such slight materials that stars of the first and second magnitudes may be seen through them. The rapidity of their motion is another circumstance calculated to afford assurance against the disasters which they might occasion, since there results from it, that the time during which they might act upon us, would necessarily be very short, and would never exceed two or three hours, as Dionis Dusegour, M. D. has demonstrated. F. G.

METEOROLOGY.

2. *An Account of the Accident to the Packet Ship the New York, from Lightning.* By T. Stewart Traill, M. D. of Liverpool. Communicated by Henry Brougham, Esq. M. P. F. R. S *.—The ship which met with the accident, of which the effects are the subject of this communication, was the American packet the New York, of 526 tons, commanded by Captain Bennet. She sailed from New York for Liverpool, on the 16th of last April; and, on the morning of the 19th, was struck by lightning, which shattered the main royal mast, and, gliding down the iron chain main-top-sail tie, burst the iron bands on the mainmast head. It was thence conducted by the iron main-top-sail sheets, to the iron work of the pumps. It then entered between decks, demolishing the bulk heads that formed the store-room, in its way to a small leaden cistern; whence it was conducted, by a leaden pipe, through the starboard side of the ship, where it started three five-inch planks, ten feet in length, at the lower part of the bends. Many other parts of the ship,

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* The above is a notice of Dr Traill's paper, which will appear in the next volume of the Philosophical Transactions.

not in the direct line of its passage, were also shattered, apparently from the effects of a lateral explosion; several doors and partitions were thrown down, a large mirror in the cabin was shivered into small fragments, and a pianoforte was thrown down, its top blown off, and broken in pieces. The loudness of the explosion was appalling, and spread universal consternation. A sulphureous smoke, which had issued with a bluish flame from the hatches, filled the cabins, and at first inspired alarm, lest the cargo in the hold, consisting chiefly of cotton and turpentine, had taken fire; but, on clearing the main hatch, it was soon ascertained that no danger from fire existed. The ship, however, had sprung a leak, which made four inches of water every hour, but which, on working the pumps, was found to be under command, and would not prevent her proceeding on her voyage to England. When the first terror created by the accident had somewhat subsided, it was found that none of the passengers or crew had sustained any injury. The chief mate was sleeping in the birth opposite to the main hatch, near the spot where the lightning entered the store-room, the lock of which was forcibly driven into his cabin; but he was not himself affected by the shock, and a quantity of gunpowder which was kept under his bed, was fortunately not ignited by the lightning. An ewer and a basin, placed in a stand over a child's bed, were thrown down by the explosion, but the child had escaped unhurt. A remarkable effect was, however, produced on an elderly gentleman, who for the last five years had not been able to walk half a-mile at a time; terrified by the crash, he forgot his debility, and, springing from his bed, rushed on deck with singular quickness and agility. He has retained, ever since the event, the power over the muscles of his limbs, derived from this sudden motion. The threatening aspect of the heavens, the appearance of numerous water-spouts on the surface of the sea, and other electrical indications, gave rise to apprehensions of further danger, and induced the captain to put up the conductor, with which he was provided, but which had not been previously applied. It was made of iron links eighteen inches long, connected by iron rings, one inch in diameter; and was furnished at the top with an iron rod, four feet long, and half an inch in diameter, tapering to a fine point. This rod was fixed so as to rise three feet above the main royal mast-head; and the chain was made to descend along the back-stay, and below was kept at a distance of ten feet from the starboard bulwarks, by a light wooden outrigger, or spar. Its whole length was 145 feet, of which about nine feet of its lower part descended into the sea. The wisdom of adopting this precaution was soon apparent, for, in the course of the same morning, the ship was struck by a second explosion, which is stated by the unanimous testimony of all on board to have far exceeded in violence the first. It melted a great part of the conductor, producing a vivid combustion of many of the links, which burned like so many tapers; and, descending into the sea, darted off to a considerable distance along the surface of the waves. The resistance to its passage was so great, as to cause the ship to recoil with a sudden and violent shock, so as to throw down several of the crew. The melted iron of the conductor fell in large drops on the deck, which, although already strewed with hailstones that had previously fallen, intermixed with rain, was set fire to in many places by the ignited metal. No damage, however, was done to the masts or rigging, nor the least injury to any of the crew, with the exception of a carpenter, who being at work with an iron auger in his hand, received a smart shock through the wrists, which occasioned a livid tumour which was still visible six weeks after the accident. Soon after the arrival of the vessel in Liverpool, she was docked, in order to ascertain what damage she had sustained. Some of her planks were found to have started, but her timbers were uninjured. Every instrument made of steel, such as the carpenter's tools, and the knives and forks, and also those made of soft iron, even to the very nails in every part of the ship, has been rendered permanently magnetic. All the watches and chronometers were either stopped or rendered useless, by the magnetism imparted to the balance-wheels and other parts of their works that were made of steel. Contrary to what usually happens from shocks of artificial electricity, the lightning had given a strong northern polarity to the upper part of the conductor. Many parts of the iron work, indeed, had acquired magnetism corresponding to their position with respect to the magnetic direction; but in others, no relation of this kind could be traced. Great changes were produced on the magnetism of the compass needles, in many of which were found several sets of poles, and their indications could therefore no longer be relied on. The circumstances attending the accident which is the subject of this paper, are considered by the author as strongly confirming the value of conductors to ships in obviating the destructive effects of lightning. From the inquiries he has made, he is led to the belief, that injuries from lightning at sea are much more frequent than is generally imagined. One source of increased danger of late years, is to be found in the greater proportion of metal, and particularly iron, which is employed in the rigging; more especially as the metallic masses are there nearly insulated, or connected only by very imperfect conductors. In the instance before us, it is in the highest degree probable, that if the New York had been without the protection of the conductor, she must inevitably have been destroyed by the second tremendous explosion, which, thus guarded, she sustained without the slightest injury. The author remarks, that copper is a better material for such a conductor than iron, from its being less liable either to fusion or corrosion; and also that a rod is, from its continuity, a better form of conductor than a chain. In the case of ships, however, the greater convenience of a chain, arising from its flexibility, will generally ensure it the preference. The author recommends that, instead of carrying the conductor through the decks to the keels, as suggested by Mr Harris, the lower end of the chain should be kept at a distance from the sides of the ship, by means of a light out-rigger or spar, as was done in the New York.

3. *On the Diurnal Course of the Thermometer.*—1. The mean daily course of the temperature of the atmosphere is the same at all hours, as is proved by the observations made by the Officers of Artillery at Leith Fort, those of Chimenello in Padua, of Dr Neuber in Apinrade, and of B. S. Dorta at Rio de Janeiro. 2. According to an yearly mean, the coldest hour of the day in Europe is 5 o'clock in the morning. 3. The warmest hour of the day, according to the Leith observations, is 3 o'clock in the afternoon, but the Padua observations make it 2 o'clock in the afternoon. 4. The progress of the heat is interrupted near to the maximum and minimum: the rise is most considerable some hours after the minimum, the fall some hours after the maximum. 5. The heat increases for 9–10 hours, decreases for 14–15 hours. 6. The greatest daily range of temperature

in Europe is about 13° Fahr. 7. At Padua the daily medium is at 8 hours 41 minutes A. M., and 7 hours 52 minutes P. M.; at Leith at 9 hours 18 minutes A. M., and 8 hours 27 minutes P. M. 8. The greatest daily range of temperature in Europe takes place in July, and the least in December.—*Schow.*

4. *Comparison of Winds, and the different heights of the Sea at Copenhagen.*—1. The N., N.W., W. and S.W., gives high-water in the Sound, but S., S.E. and N.E. low-water; N.W. the highest, E. the lowest medium level. 2. The oscillations in the height of the sea depend principally on the winds.

5. *Comparison of Winds with the Currents in the Sea near to Copenhagen.*—1. The southerly current is most frequent during the south wind, the northern during the north wind, &c. 2. The principal cause of the currents in the Sound is the wind. —*Schow.*

6. *Temperature of common Perennial Springs.*—It is a general opinion, that these springs derive their temperature from the strata they traverse, which strata, it is maintained, obtain other heat directly by transmission from the atmosphere. It is much more probable, that such springs derive their temperature chiefly from the percolating *atmospheric water.* The experiments made at Raith in Fifeshire, do not prove any thing in favour of the first opinion, and are opposed to the latter. The heat of the soil, and superficial strata in the north, and the comparative low temperature of springs from the south of Europe to the tropic of Cancer, are to be traced to the percolating water.

7. *Account of a Hurricane.*—When the ships were ready to depart, a terrible storm swept the island. It was one of those awful whirlwinds which occasionally rage within the tropics, and which were called by the Indians *furicans* or *uricans*, a name which they still retain with trifling variation. About mid-day a furious wind sprang up from the east, driving before it dense volumes of cloud and vapour. Encountering another tempest of wind from the west, it appeared as if a violent conflict ensued. The clouds were rent by incessant flashes, or rather streams of lightning. At one time they were piled up high in the sky; at another they descended to the earth, filling the air with a baleful darkness, more impenetrable than the obscurity of midnight. Wherever the whirlwind passed, whole tracts of fo-

rests were shivered and stripped of their leaves and branches: those of gigantic size, which resisted the blast, were torn up by the roots, and hurled to a great distance. Groves were torn from the mountain precipices; and vast masses of earth and rock precipitated into the valleys with terrific noise, choking the course of the rivers. The fearful sounds in the air and on the earth; the pealing thunder; the vivid lightning: the howling of the wind; the crash of falling trees and rocks, filled every one with affright; and many thought that the end of the world was at hand. Some fled to caverns for safety, for their frail houses were blown down, and the air was filled with the trunks and branches of trees, and even with fragments of rocks, carried along by the fury of the tempest. When the hurricane reached the harbour, it whirled the ships round as they lay at anchor; snapped their cables, and sank three of them to the bottom, with all who were on board. Others were driven about, dashed against each other, and tossed mere wrecks upon the shore, by the swelling surges of the sea, which, in some places, rolled for three or four miles upon the land. The tempest lasted for three hours. When it had passed away, and the sun again appeared, the Indians regarded each other in mute astonishment and dismay. Never in their memory, nor in the traditions of their ancestors, had their island been visited by such a tremendous storm. They believed that the Deity had sent this fearful ruin to punish the cruelties and crimes of the white men; and declared that this people had moved the very air, the water, and the earth, to disturb their tranquil life, and to desolate their island. —*Irving's Life of Columbus*, vol. ii. p. 305.

NATURAL PHILOSOPHY.

8. *Relations between Electricity and Heat.*—M. Becquerel read a memoir on the relations that may exist between electricity and heat. The author conceived, that, in order to ascend to the origin of electrical phenomena produced by heat, it was necessary to seek in the bodies which are bad conductors of electricity, properties having some analogy with those which heat developes in tourmaline. The experiments which he made with this object afforded him the following results:—A small cylinder of glass or gum lac, suspended by a silk thread in the inte-

rior of a bell heated to 25°, is attracted by a stick of gum lac, the moment it begins to cool. The attraction continues so long as the cooling lasts. If the small cylinder has been raised to 80°, it will acquire, during refrigeration, besides the property of attracting, two electrical poles, which disappear when the temperature rises. At 100° and 150°, the phenomena are the same. Thus, under the influence of an electrified body, a small glass cylinder acquires, at the moment of cooling, two electrical poles, which vanish rapidly when the temperature is raised. These effects are analogous to those which tourmaline presents in the same circumstances, with this difference, that the development of electricity in the latter is produced by circumstances of crystallisation. Whence it may be concluded, that, in the expansion of bodies, there is an absorption of electricity, and probably an emission during contraction. M. Ampère's ingenious theory regarding the electrical nature of atoms, accounts in a satisfactory manner for these important facts. M. Becquerel then gave an account of the new researches which he has made with respect to tourmalines, from which there results, that these minerals, when of a certain length, are not electrified by any of the means of exciting that power with the assistance of heat; that, in proportion as they diminish in size, they become more electrical; and that, admitting this law to continue to the smallest particles of bodies, these must assume a considerable electrical intensity on the application of weak variations of temperature. The facts contained in this memoir appear to have thrown much light upon the electrical state of atoms. M. Becquerel is of opinion, that they are capable of leading to accurate ideas respecting the cause of the great phenomena of nature. All kinds of glass are not adapted for the experiment. Those which are highly alkaline (and almost all that are made at present are of this kind) are too bad conductors to allow the phenomena, announced by M. Becquerel, to be observed. That learned gentleman owed the discovery of the remarkable facts which he made known to a fortunate chance, which led him to make use of glasses manufactured fifty years ago. When he used glass of the present day, all the phenomena disappeared. He soon discovered that this was owing to the great quantity of soda employed in the manufacture of glass at present.

9. *Cuvier's explanation of accidental Colours.*—M. G. Cuvier thinks, that the production of all the accidental colours may be explained by this very simple fact, that the retina which has just been subjected to the impression of a colour, becomes, from this very circumstance, incapable of immediately receiving the impression of a fainter colour of the same kind. A very simple experiment, and one which every body has made, without reflecting upon it, confirms this truth. When toward evening, one looks to a window, he sees the wood surrounding the panes of a dark colour, while the latter are still light. If, after looking steadily for some time at the window, he turns toward the opposite side of the room, which is darker, he sees there an image of the window. This phenomenon can only be explained by admitting, that the part of the retina on which the image of the window is painted, becomes, in consequence of the vivacity of the colours of which the image was formed, incapable of receiving any impression on the part of the dark points of the opposite side of the room; whence results the image seen on the wall. The phenomenon which the retina presents in this case exists more or less with respect to all our senses; each of which, after being submitted to a rather vivid impression, becomes, from that very circumstance, incapable of experiencing a weaker impression of the same nature. It is enough to eat a bit of sugar immediately before taking one's coffee, to find that the coffee is not sufficiently sweet. What takes place in this case, with reference to the sense of taste, is analogous to what was observed with respect to the sense of sight in the case of the window. The application of this to the phenomenon of accidental colours is easy. If, for example, an ace of diamonds be fixed on a card, one can only look at it for a very short time, without letting his eyes vacillate to either side. From this moment, the eye, having become insensible to the red rays, will only see in the white of the card, the green of the band of that colour which surrounds the red. What proves the accuracy of this explanation is, that if, after looking at the red ace, one directs his eye to a distant part of the card, he sees a figure of the same form, and of a green colour, the perception of which is owing to the cause already pointed out.

10. *Motions of the Magnetic Equator.*—M. Morellet ad-

dressed a memoir to the Academy *on the motions of the magnetic equator*, 12th May 1828. In the letter accompanying it, the author, after mentioning that his previous labours, on the same subject, were honoured with the approbation of the Academy, exposes the new results which he has obtained. The discussion of the observations made by Captain Duperrey has confirmed him in the opinion which he held: *1st*, That the magnetic equator is not fixed: *2dly*, That it is not animated by any regular motion, whether from west to east, or in any other direction: *3dly*, That it shifts in an apparently irregular manner, changing form according to laws which it would be important to know. These laws, the author attempts to present in his memoir, and to determine beforehand the position which the equator will assume in a given time. Experience, he says, has already confirmed some of his views in this respect.

11. *Compressibility of Water.*—Oersted finds, in conformity with the previous experiments of Canton, that water is more compressible at the freezing point than at a higher temperature. At 32° Fahrenheit the compressibility of water is about a tenth greater than at 34½° Fahrenheit. At higher temperatures it is still less, but not in so high a proportion.

CHEMISTRY.

12. *Method of detecting the presence of Potash before the blowpipe, by means of Oxide of Nickel.*—Mr Harkort, the discoverer of this test, directs it to be used in the following manner: Dissolve the oxide of nickel in borax, add to the glass a little native felspar, or any other body containing potash, and we obtain by fusion *a blue glass*. The presence of natron does not prevent this reaction. Of the nickeliferous preparations we may employ either nitrate or oxalate of oxide of nickel. The latter is more easily obtained in a solid form, and deserves, in this respect, the preference. It is, however, necessary that the oxide of nickel be free of oxide of cobalt, although it yields with borax a brown in place of a blue glass. The blue colour which the oxide of nickel affords with the potash, is different from that afforded by oxide of cobalt.

MINERALOGY.

13. *Strontian in Aphrite.*—Breithaupt has proved, by experiment, the accuracy of his hypothesis regarding the existence of strontian earth in *aphrite*, by detecting it in that mineral.

14. *Calcareous Heavy Spar*, or Curved Lamellar Heavy Spar, which, is by Breithaupt, arranged as a distinct species, exhibits the following characters: Prevailing colour white, sometimes also red, grey and brown. Same primitive form as common heavy spar. Crystals are reniformly or globularly grouped. Lustre of principal cleavage pearly, of others vitreous. Translucent. It decays more readily than common heavy spar, and in lustre and structure resembles anhydrite. From a series of experiments with heavy spar, celestine, and calc-heavy spar, it results, in regard to specific gravity, that celestine = 3.93 to 3,96; calc-heavy spar = 4.02 to 4.29, and heavy spar = 4.30 to 4.58. It appears that all straight lamellar heavy spars are not true heavy spar, and that no curved lamellar heavy spar is really common heavy spar. The calc-heavy spar is a compound of sulphate of barytes and sulphate of lime.

15. *Calaite or Mineral Turquois discovered in Lower Silesia.*—The principal rock from the village of *Yäschwiz* to *Steine* is flinty slate. In rents of that rock there occur quartz, asbestus, talc, and *calaite*. The calaite either fills up small veins, or incrusts their walls in small reniform masses.

16. *Crysoprase and Chromate of Iron.*—The serpentine of Silesia, which is associated with gabbro, (as at Ballantrae in Ayrshire), is traversed with numerous veins, in which there occur quartz, calcedony, hornstone, *semiopal*, *cacholong*, *crysoprase*, *magnesite*, *pimelite*, asbestus, talc, and *kerolite*. In some places there are veins of chromate of iron, three feet thick. Semiopal has been found in the serpentine of Scotland, but no one has hitherto discovered in it the more valuable and more beautiful mineral the crysoprase, although we are confident that it occurs in this country.

17. *Datolite discovered at Andreasberg.*—Since the discovery of datolite at Arendal, in Norway, it has been found in the Tyrol, and a few other places. Lately fine crystals of this rare mineral have been met with in the veins, along with quartz in

greenstone, subordinate to clay-slate, in the district of Andreasberg, in the Hartz. It is worthy of notice, that the same greenstone contains axinite, another species which, also like datolite, contains boracic acid. Stromeyer finds its specific gravity to be 3.3541; and its constituent parts, lime 36.67; silica 37.36; boracic acid 21.26; water 5.71.

18. *Haytorite.*—This mineral, which appears to be a variety of rhomboidal quartz, according to Wöhler, is composed of silica, 98.5, and iron oxide 0.2. In the analysis a loss of 0.5.

19. *On the Electricity disengaged by the cleavage of regularly crystallized bodies; by M. Becquerel.*—Many facts shew, that when adhesion takes place between two bodies, in consequence of a reciprocal attraction between the surfaces, and one of them is not a good conductor of electricity, they each assume an excess of opposite electricity at the moment of their separation. For example, glass, gum-lac, &c. immersed in mercury, exercise a certain adhesion to it; and, on being withdrawn, are found to have acquired an excess of electricity, the species of which depends upon particular circumstances, which M. Dessaignes has carefully described. Gum-lac, melted and poured upon glass, contracts an adherence to it, as is known; on being separated, they each assume an excess of opposite electricity. It is extremely probable that glass, gum-lac, and other bodies immersed in water, would come out electrified, did not the molecules of the liquid stick to their surface, that is to say, did not the affinity of water for these bodies exceed that of the molecules for each other. In like manner, in the electrical experiments of pressure, there is always obtained a development of electricity, so much the greater the stronger the adhesion between the compressed bodies. For example, on withdrawing from pressure two bits of cork, a slight resistance is sometimes experienced; the disengagement of electricity is then more considerable than if there had been no adhesion. Similar effects are especially observed, when cork or elder pith is pressed against a perfectly polished diamond facet. Some natural philosophers have attributed them to the friction which the molecules experience at the moment of separation of the two bodies. This explanation does not appear to be correct, for the above experiment evidently proves, that the partial frictions which the mole-

cules undergo when the pressure is diminished, have no influence in modifying the disengagement of electricity. Elasticity is therefore a principal cause of the effects. The electrical phenomena of pressure and those of cleavage have strong relations to each other; for, when plates of mica or selenite are quickly separated, each of them bears an excess of opposite electricity. If they are brought together again, and placed in the position which they originally occupied, a slight pressure being at the same time applied, the same electrical phenomena are obtained as when they were separated. We therefore see, that pressure, which effects a mechanical approximation of the molecules, produces the same effects as the force of aggregation, which only determines a more immediate contact of the same molecules. These phenomena do not take place indefinitely; for the exposure to the air of newly cleft laminæ deprives them pretty rapidly of their electrical propensity, perhaps on account of the hygrometric water which they absorb. All regularly crystallized substances possess the same property as mica and sulphate of lime. I have proved it with respect to Iceland spar, sulphate of barytes, fluate of lime, topaz, &c. It is essential that the crystal be regularly split, for when it is fractured, it manifests no electrical effect. It may, in fact, be easily conceived, that, if the cleavage is not distinct, there may be laminæ which assume one electricity, and others a contrary electricity. It then happens that the sum of all these electricities may be nothing, which is most commonly the case. Topaz presents only one direction of cleavage, perpendicular to the axis of the crystal, according to which the distribution of the electricity takes place, when the temperature of this substance is raised to a certain degree. The most natural supposition which suggests itself is, that the laminæ being in two different states of electricity at the moment of their separation, may be considered as the elements of a pile. Now, this is not the case, for it would be necessary that the laminæ similarly situated with relation to one of the summits of the crystal, should always assume the same electricity by cleavage; which does not happen, as one electricity is sometimes obtained, and sometimes another. Thus the kind of electricity depends upon circumstances peculiar to the cleavage, and not upon the position of the laminæ. There takes place, therefore, at the moment when it is produced, a movement in the molecules, which determines each surface to assume the one or other electricity.—*Annales de Chim. et de Phys.*, *Nov.* 1827.

20. *Botryogen, a new Mineral Species.*—G. Rose has published descriptions of some new varieties of form observed by him in the tessular system of crystallisation; Mr Haidinger, a description, with figures, of the different forms of red sulphat of iron, which he names, from its botryoidal form, *Botryogen;* and M. F. Tamnau, an account of the prismatic forms of *Dichroite.* These memoirs are contained in No. 3. for 1828, of Poggendorf's Journal.

21. *Octahedral Borax.*—It is well known that common borax, which occurs in tetarto-prismatic crystals, contains 10 atoms of water of crystallization, with a specific gravity of 1.740. According to Payen (*Journ. de Chim. Med.* 1828, No. 4. p. 153), it is capable of assuming another form, the octahedral, and then it contains only 5 atoms of water, has a specific gravity of 1.815, and is harder than common borax.

22. *Blue colour of Dichroite, not characteristic for it.*—The blue colour of dichroite does not appear to be characteristic, for M. Tamnau says, he has seen many crystals which were nearly transparent, of a pure white colour, in whatever direction in regard to the axis they were viewed. When in this state, and if the planes of the crystals are imperfectly seen, it is difficult to distinguish them from quartz-crystal, with which they occur imbedded on magnetic pyrites.—*F. Tamnau, Poggendorf's Journal,* No. 3. 1828.

23. *Borate of Barytes.*—When this substance is melted, and then cut and polished, it exhibits a high degree of lustre, and closely resembles the topaz of Saxony.

GEOGRAPHY.

24. *Union of the Atlantic and Pacific.*—It appears by letters from Amsterdam, that the project of cutting a canal, to unite the Gulf of Mexico with the Pacific Ocean, is about to be revived under the auspices of the Netherlands government, which has entered into communication with the government of Guatemala, or Central America, for that purpose. General Van

Veer, who was deputed on that mission, has just returned to Europe, and it is stated that several persons are on their way to the Netherlands from Guatemala, who are authorized to carry into effect the arrangements connected with the undertaking. Some exclusive advantages, as an inducement to engage in the project, have been offered to the Dutch government; and it is said that the king himself has entered into it with so much earnestness, that he has composed a long memoir, to point out its probability of success, and the benefits with which it will be attended. A vessel has been ordered to be in readiness to carry out to Guatemala the engineers and persons appointed to survey the ground through which the proposed canal is to pass.

25. *Island of Lingga, residence of the primitive Malays.*—In the last volume of the Transactions of the Batavian Society of Arts and Sciences, is an interesting paper by M. Van Angelbeck, on the Island of Lingga. It is divided into three parts. In the first, he considers the island in a geological point of view; the second he devotes to the history and moral condition of the Malays; and in the third he describes their government, trade, and occupations. *The island of Lingga is the actual residence of the primitive Malays.* Its capital, called *Kwala Dai*, is the ordinary place of abode of the Sultan. Its climate is healthy; and there are but few diseases, the principal of which are cutaneous. This island is very mountainous, and is covered with wood. In its forests grows the fine tree called *Chalcas paniculata*, and the soil indicates the presence of rich tin mines. It is also said that there is some gold. M. Van Angelbeck observes that the country is magnificent; that nature shews herself there in all her force; but that it is vexatious to see that the natives benefit only partially from its fertility. They devote themselves but little to agriculture, which is held in disesteem. Fishing is almost their sole occupation, and the fish are abundant and excellent.—*Asiatic Journal, December* 1827.

GEOLOGY.

26. *On the Phenomena of Volcanoes; by Sir H. Davy, Bart. F. R. S.* *—In a paper on the Decomposition of the Earths,

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* The above is a notice of a Memoir lately read before the Royal Society of London.

published in the Philosophical Transactions for 1812, the author offered it as a conjecture, that the metals of the alkalies and earths might exist in the interior of the globe; and, on being exposed to the action of air and water, give rise to volcanic fires, and to the production of lavas, by the slow cooling of which, basaltic and other crystalline rocks might subsequently be formed. Vesuvius, from local circumstances, presents peculiar advantages for investigating the truth of this hypothesis; and of these the author availed himself during his residence at Naples, in the months of December 1819, and of January and February 1820. A small eruption had taken place a few days before he visited that mountain, and a stream of lava was then flowing, with considerable activity, from an aperture in the mountain a little below the crater, which was throwing up showers of red hot stones every two or three minutes. On its issuing from the mountains it was perfectly fluid, and nearly white hot; its surface appeared to be in violent agitation from the bursting of numerous bubbles, which emitted clouds of white smoke. There was no appearance of vivid ignition in the lava when it was raised, and poured out by an iron ladle. A portion was thrown into a glass bottle, which was then closed with a ground stopper, and, on examining the air in the bottle some time afterwards, it was found not to have lost any of its oxygen. Nitre thrown upon the surface of the lava did not produce such an increase of ignition, as would have attended the presence of combustible matter. The gas disengaged from the lava proved, on examination, to be common air. When the white vapours were condensed on a cold tin plate, the deposit was found to consist of very pure common salt; and the vapours themselves contained nine per cent. of oxygen, the rest being azote, without any notable proportion of carbonic acid or sulphurous acid gases; although the fumes of the latter of these gases were exceedingly pungent in the smoke from the crater of the volcano. On another occasion, the author examined the saline incrustrations in the rocks near the ancient bocca of Vesuvius; and found them to consist principally of common salt, with some chloride of iron,—a little sulphate of soda,—and a still smaller quantity of sulphate or muriate of potassa, with a minute portion of oxide of copper. In one instance, in which the crystals had a purplish tint, a trace of muriate of cobalt was detected. From the observations made by the author at different periods, he concludes, that the dense white smoke which rose in immense columns from the stream of lava, and which reflected the morning and evening light of the purest tints of red and orange, was produced by the salts which were sublimed with the steam. It presented a striking contrast to the black smoke arising from the crater, which was loaded with earthy particles, and which, in the night, was highly luminous at the moment of the explosion. The phenomena observed by the author afford a sufficient refutation of all the ancient hypotheses, in which volcanic fires were ascribed to such chemical causes, as the combustion of mineral coal, or the action of sulphur upon iron; and are perfectly consistent with the supposition of their depending upon the oxidation of the metals of the earths upon an extensive scale, in immense subterranean cavities, to which water, or atmospheric air, may occasionally have access. The subterranean thunder heard at great distances under Vesuvius, prior to an eruption, indicates the vast extent of these cavities; and the existence of a subterranean communication between the Solfatara and Vesuvius, is established by the fact that, whenever the latter is in an active state, the former is comparatively tranquil. In confirmation of these views the author remarks, that almost all volcanoes of considerable magnitude in the old world are in the vicinity of the sea; and, in those where the sea is more distant, as in the volcanoes of South America, the water may be supplied from great subterranean lakes; for Humbolt states, that some of them throw up quantities of fish. The author acknowledges, however, that the hypothesis of the nucleus of the globe being composed of matter liquefied by heat, offers a still more simple solution of the phenomena of volcanic fires.

27. *Fossil Rib of a Whale, discovered in Diluvium near Kemp Town, Brighton.*—A short time since, a man employed in collecting stones from the beach, near Black-Rock, observed a huge body projecting from the base of the cliff; after satisfying himself of its nature, by breaking off a large mass of it, he covered the spot with a heap of sand, and informed the Rev. Mr Wallace of Brighton of the discovery. Mr W. transmitted the intelligence to Mr Mantell of Castle Place, in this town (a gentle-

man well known in the scientific world), who went over on Monday last, and proceeded with Mr Wallace to examine this extraordinary relic. After several hours incessant labour, an excavation was made in the cliff to the extent of nearly four yards, and the stone and sand which surrounded the bone were carefully cleared away, and the latter completely exposed to view uninjured; but such was the fragile state of the specimen, that, upon attempting to remove it, the whole mass fell to pieces. The length of the bone (including the portion broken off by the labourer) was about twelve feet, being upwards of thirty inches in circumference at the largest extremity; when perfect, it must have exceeded twenty feet in length. From the structure, form, and size of the bone, there can be no doubt that it was a portion of a rib of some species of whale; and we believe it is the only instance of the remains of this animal having been found in the diluvial deposites of England. The stratum in which it occurred is stated in Mr Mantell's Geology of Sussex, to contain the bones and teeth of the elephant, horse, ox, and deer; an assemblage of organic remains not uncommon in similar strata in other parts of England. These beds lie above the chalk: and the plain on which part of Brighton, the Palace, New Church, &c. are situated, is formed by the alluvial detritus or rubbish, which has filled up a valley in the chalk. Some of the largest fragments of the bone are removed to Mr Mantell's museum in this town; others are in the possession of the labourer who made the discovery.

28. *Fossil Didelphis.*—Baron Cuvier presented to the French Academy of Sciences, a portion of the fossil jaw-bone of a carnivorous animal lately discovered in the gypsum quarries of Montmartre, which can only be compared with the *Didelphis cynocephala* of Van Dieman's Land.—*Globe.*

29. *Artificial Lightning Tubes.*—M. Beudant communicated to the *Academie des Sciences* the results which he has obtained, conjointly with MM. Hachette and Savart, respecting the formation of artificial lightning tubes. Natural philosophers have, for a considerable time, been satisfied as to the cause to which the formation of the vitreous tubes occurring in elevated sandy districts ought to be referred. The name of lightning tubes that has been given them, sufficiently indicates their being regarded as produced by lightning, which melts the sand to a considerable depth, so as to form a tube, commonly sinuous, with solids and mooth

walls internally, and rough on the outside. Our readers will recollect, that very lately a young German naturalist presented to the Academy some of these tubes, the length of which extended to seventeen feet. Without harbouring any doubt respecting the mode of formation of these tubes, it has been asked, how electricity could produce effects so intense, and which have been considered so different from those obtained from artificial electricity. The authors of the experiments, the results of which M. Beudant communicated to the Academy, formed the idea of attempting to produce lightning tubes by artificial electricity. They employed, for this purpose, Charles's battery, at present in the College of France, and actually succeeded in forming fragments of tubes perfectly resembling the natural lightning tubes, only that their walls were less solid, and their length did not exceed a few centimeters.

ZOOLOGY.

30. *Cuckoo kept alive in confinement for nearly a year past.*—This specimen was taken from the nest of a titlark, near the village of Currie, in the end of July 1827. It was then apparently about a fortnight old, and was not fully fledged until six weeks after. At first it was fed with bread and raw eggs made up into a paste. After this, it was fed with roasted meat cut into small pieces; and ultimately with raw meat, which it prefers, but will not take unless perfectly fresh. At present it eats about a pound of meat weekly. It is very fond of insects of all kinds, and in autumn seemed to prefer the larvæ of butterflies. Its first moult commenced in the end of March last. Previous to this, the colour of the upper parts was deep brown, spotted with reddish-brown; the breast and belly greyish-white, with transverse bars of brown. During winter, it was dull through the day, and restless at night, flapping its wings for hours together. At present, it is active through the day, and quiet at night. About the beginning of March it was first heard to utter its peculiar cry, which it has repeated many times since; and one morning in the end of April it continued crying for a whole hour. Its chirping cry was given up about January. At present*

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* The specimen was shewn at a meeting of the Wernerian Society 19th April 1828; but, unfortunately, at the beginning of this month, June 1828, it was choked, in attempting to swallow some moss which chanced to be in its cage.

it has a sharp weak scream, which it utters on being frightened or irritated. It did not eat of itself until nearly three months after it was found. It has always been very fond of heat, and is extremely sensible to cold, shivering intensely when the temperature is low. When the sun shines upon it, it expands all its feathers, especially those of the tail and wings, turning its back to the heat. When eating, it holds the piece of meat about three or four seconds, squeezing it with the points of its mandibles, which is supposed to be an instinctive action, the object of which is to deprive its prey of life, previous to swallowing it.—The late Mr Templeton of Belfast succeeded in keeping a cuckoo over winter, but it died in March, when the first moult commenced.

31. *Respiration of the Crustacea.*—MM. Audouin and Milne Edwards, read lately to the French Academy of Sciences a fourth memoir "on the Anatomy and Physiology of the Crustacea." The following is the title of their new memoir: *De la Respiration aërienne des Crustacés, et des modifications que l'appareil branchial éprouve dans les crabes terrestres.* There result from the observations and experiments contained in this memoir, 1. That, in all the crustacea, the branchiæ are fitted to perform the functions of respiratory organs, in the air as well as in water; 2. That the more or less rapid death of the aquatic species exposed to the air depends upon various causes, of which one of the most direct is the evaporation from the branchiæ, which produces their desiccation; 3. That, consequently, one of the conditions necessary for the support of life in animals, which have branchiæ, and live in the air, is the having these organs defended against desiccation; and, lastly, That these indispensable dispositions are actually met with in the tourlouroux and other land crabs, which all possess various organs destined for absorbing and keeping in reserve the quantity of water necessary for maintaining a suitable degree of moisture in the branchiæ.

32. *Snake-catchers.*—The secret of rendering docile, and handling with impunity, the most venomous serpents, which has so long been in the possession of the inhabitants of Western India, is not unknown in China. It is observed that the native snake-catchers here rub their hands, previously to taking hold of the snake, with an antidote composed of pounded herbs. The virtue of the preparation is such, that they hold with the naked

hand, and provoke fearlessly the deadly cobra-di-capello, or spectacle viper, a serpent which, next to the rattle-snake of North America, is perhaps one of the most dangerous reptiles in existence. This serpent, in common with others of a similar nature, are not unfrequently met with in Canton in the possession of these men, who, for a trifling gratuity, exhibit them to the curious spectator.—*Canton Register.*

33. *Siliceous Spicula in Alcyonium cydonium, and A. lyncurium.*—Dr Nardo of Chioggia finds that the spiculæ of these species are not corneous or calcareous, as some maintain, but siliceous,—an observation, however, which had been previously made in this country by Dr Grant.

ANTHROPOLOGY.

34. *Original Country of the Caribs.*—That many of the pictures given us of this extraordinary race of people have been coloured by the fears of the Indians, and the prejudices of the Spaniards, is highly probable. They were constantly the terror of the former, and the brave and obstinate opponents of the latter. The evidences adduced of their cannibal propensities, must be considered with large allowances for the careless and inaccurate observations of seafaring men, and the preconceived belief of the fact, which existed in the minds of the Spaniards. It was a custom among the natives of many of the islands, and of other parts of the New World, to preserve the remains of their deceased relatives and friends; sometimes the entire body; sometimes only the head, or some of the limbs, dried at the fire; sometimes the mere bones. These, when found in the dwellings of the natives of Hispaniola, against whom no prejudice of the kind existed, were correctly regarded as relics of the deceased, preserved through affection or reverence; but any remains of the kind found among the Caribs, were looked upon with horror as proofs of cannibalism. The warlike and unyielding character of these people, so different from that of the pusillanimous nations around them, and the wide scope of their enterprises and wanderings, like those of the Nomade tribes of the Old World, entitle them to distinguished attention. They were trained to war from their infancy. As soon as they could walk, their intrepid mothers put in their hands the bow and arrow, and prepared them to take an early part in the hardy enterprises of

their fathers. Their distant roamings by sea made them observant and intelligent. The natives of the other islands only knew how to divide time by day and night, by the sun and moon; whereas these had acquired some knowledge of the stars, by which to calculate the times and seasons. The traditional accounts of their origin, though, of course, extremely vague, are yet capable of being verified, to a great degree, by geographical facts, and open one of the rich veins of curious inquiry and speculation which abound in the New World. They are said to have migrated from the remote valleys embosomed in the Apalachian Mountains. The earliest accounts we have of them, represent them with their weapons in their hands, continually engaged in wars, winning their way, and shifting their abode, until, in the course of time, they found themselves at the extremity of Florida. Here, abandoning the northern continent, they passed over to the Lucayos, and from thence gradually, in the process of years, from island to island of that vast and verdant chain, which links, as it were, the end of Florida to the coast of Paria, on the southern continent. The Archipelago, extending from Porto Rico to Tobago, was their stronghold, and the Island of Guadaloupe, in a manner, their citadel. Hence they made their expeditions, and spread the terror of their name through all the surrounding countries. Swarms of them landed upon the southern continent, and overran some parts of Terra Firma. Traces of them have been discovered far in the interior of the country through which flows the Oroonoko. The Dutch found colonies of them on the banks of the Ikouteka, which empties into the Surinam, along the Esquibi, the Maroni, and other rivers of Guayana, and in the country watered by the windings of the Cayenne; and it would appear that they have extended their wanderings to the shores of the Southern Ocean, where, among the aboriginals of Brazil, were some who called themselves Caribs, distinguished from the surrounding Indians by their superior hardihood, subtlety, and enterprise. To trace the footsteps of this roving tribe throughout its wide migrations, from the Apalachian Mountains of the Northern Continent, along the clusters of islands which stud the Gulf of Mexico and the Caribbean Sea, to the shores of Paria, and so across the vast regions of Guayana and Amazonia, to the remote coast of Brazil, would be one of the most curious researches in aboriginal history, and might throw much light upon the mysterious question of the population of the New World.—*Irving's Life of Columbus.*

BOTANY.

35. *Temperature of Plants.*—Schutzer and Halder have published, at Tübingen, an account of some experiments on this subject. They inserted thermometers into the stems of trees, and so deep that the bulb reached the centre of the tree. The same was done into a dead stem. It results from these experiments, that vegetables appear to retain a certain medium temperature, which cannot however be considered as originating from heat evolved by the functions of the plant, as the dead stem afforded the same temperature as the living, but can be satisfactorily explained by a reference to the bad conducting power of the vegetable fibre and the wood, by which the temperature of the surrounding aërial strata penetrates but slowly into the interior of the plant.

ARTS.

36. *On preserving Wine in Draught. By M. Imery.*—M. Imery of Toulouse has given us the following simple means of preserving wine in draught for a considerable time; it is sufficient to pour into the cask a flask of fine olive oil. The wine may thus continue in draught for more than a year. It is by a similar process, that they preserve wine in Tuscany, which they are accustomed to keep in large bottles, the glass of which is too thin to resist the effect of corking them tight. The oil, spread in a thin layer upon the surface of the wine, hinders the evaporation of its alcoholic part, as well as prevents it from combining with the atmospheric air, which would not only turn the wine sour, but also change its constituent parts.—*Gill's Technological Repository, May* 1828.

37. *On an effectual cure for Smoky Chimneys. By Mr S. Mordan.*—Mr Mordan, the patentee of the ever pointed pencils, shewed the editor lately his contrivance for preventing his kitchen chimney from smoking, and also for quickly exciting his fire, without the aid of bellows. This fire-place, like many others, had a wide open chimney to it, and was continually annoying his family by smoking. He determined, therefore, to con-

tract the throat of his chimney in the following judicious manner. He caused the entire opening at the bottom or throat of the chimney to be closed up, with the exception of an upright flue, just above the top of the grate, about a foot wide and high, and which led into the chimney. To the face of this flue he applied a square flat frame of wrought iron, having upright grooves made on each side of it, in which a sort of hood, made of sheet-iron, could slide up and down. This hood is open behind; it projects about a foot square in front of the chimney back, over the fire-place or grate; it is sloped off at its top, towards the back of the chimney, and it has a handle in front of it to raise and lower it by. When the hood is elevated, it serves to guide the smoke and heated air into the upright opening leading into the chimney, its sides being closed to fit the upright back of the fire-place; and the fire then burns in the usual manner, but the chimney never smokes. When, however, he wishes to excite the fire at any time, he lowers the hood until its bottom nearly reaches down to the tops of the cheeks, or two keepers of the grate, and the fire, by the draught thus caused, instantly revives. In addition to this hood, he likewise occasionally hangs upon ledges, formed upon each side of it, an appendage made of sheet-iron, which lengthens it so that its sides fit close upon the tops of the keepers, and thus the air can only gain access to the fire through the front and bottom bars of the grate, and then, indeed, the fire burns most vehemently.—*Gill's Technological Repository, May* 1828.

List of Patents granted in England from 1*st February to* 19*th April* 1828.

1828.

Feb. 1. To **Robert Barlow**, of Jubilee Place, Chelsea, county of Middlesex; for "a new motion for superseding the necessity of the ordinary Crank in Steam-Engines."

To **John Frederick Daniel**, Esq. of Gower Street, Bedford Square, London; for "improvements in the manufacture of Gas."

To **John Oldham**, of the City of Dublin, gentleman; for "improvements in Wheels for driving machinery, to be impelled by water or wind, also applicable to boats and other vessels."

To **Ralph Hindmarsh**, Newcastle-upon-Tyne, Master-mariner; for "an improvement in Capstans and Windlasses."

To **Robert Stirling**, Minister of Galston, Ayrshire; and **James Stirling**, Engineer in Glasgow, Lanarkshire; for "improvements in Air-Engines for moving machinery."

To **John White** of Southampton, county of Hants, engineer and iron-founder; for "improvements in Pistons or Buckets for pumps."

To **Samuel Parker** of Argyll Place, Argyll Street, Westminster, bronzist; for "improvements in the construction of Lamps."

3. To **Antoine Adolphe Marcellin Marbott**, Norfolk Street, Strand, London, merchant; for "improvements in Machinery for Cutting Wood into Moulding, Rebates, &c. communicated from abroad."

8. To Sir **William Congreve**, of Cecil Street, Strand, London, Bart.; for a "new Motive power."

12. To **William Stratton** of Limehouse, county of Middlesex, engineer; for "an improved apparatus for Heating Air by Steam."

14. To **John George Christ**, Old City Chambers, London; for "improvements in Copper and other Plate Printing, communicated from abroad."

20. To **Philip Jacob Heisch**, of America Square, London, merchant; for "improvements in Machinery for Spinning Cotton, communicated from abroad."

To **Charles Barwell Coles**, late of Duke Street, Manchester Square, London, Esq.; and **William Nicholson** of Manchester, in the county of Lancashire, civil-engineer; for "a new method of contructing Gasometers, or machines for holding and distributing Gas,—communicated from abroad."

To **William Benecke** of Deptford, Kent, gentleman; for a machine for Grinding Seeds for the extraction of oil,—communicated from abroad.

To **William Jeffries** of London Street, Radcliffe, Middlesex; brass-manufacturer; for "improvements in Calcining, Roasting, &c. Ores."

To **Pierre Erard**, of Great Marlborough Street, county of Middlesex, musical-instrument maker; for "improvements in Piano-fortes,—communicated from abroad."

To **Augustus**, Count de la **Garde**, of St James' Square, London; for "a method of making Paper from the ligneous parts of certain textile plants,—communicated from abroad."

To **William Smith** of Sheffield, county of York, merchant; for "an improved method of manufacturing Cutlery, by means of Rollers."

21. To **Caleb Hitch** the Younger, of Ware, in the county of Hertford, brick-maker; for "an improved Wall for building purposes."

To **George Dickenson**, of Buckland Mill, near Dover, county of Kent, paper manufacturer; for "improvements in making Paper by Machinery."

To **Angelo Benedetto Vanhera**, of Cirencester Place, Fitzroy Square, London, professor of music; for "improvements on the Harp, Lute, and Spanish Guitar."

To David Bentley, of Pendleton, county of Lancaster, bleacher; for "an improved method of bleaching, and improvement in machinery for bleaching and finishing Linen or Cotton."

To William Brunton, of Leadendall Street, London, civil engineer; for "improvements on Furnaces for the calcination, &c. of Ores, Metals and other substances."

March 3. To John Levers, of Nottingham, machine maker; for "improvements in Machinery, for the manufacture of Bobin-net Lace."

6. To William Pownall, of Manchester, county of Lancaster, weaver; for "improvements in making Healds, for weaving purposes."

To Bernard Henry Brook, of Huddersfield, county of York, civil engineer; for "improvements in Ovens or Retorts, for carbonizing coal."

13. To William Rogers, of Norfolk Street, Strand, London, Lieutenant in the Royal Navy; for "improvements on Anchors."

To Robert Griffith Jones, of Brewer Street, Golden Square, London, gentleman, for "a method of ornamenting China, communicated from abroad."

15. To George Scholefield, of Leeds, county of York, mechanic; for "improvements in Looms."

20. To Nathan Gough, of Salford, county of Lancaster, civil engineer; for "an improved method of propelling Carriages or Vessels, by Steam or other power."

To Samuel Clegg, of Chapel Walks, Liverpool, county of Lancaster; for "improvements in Steam-engines, and Steam-boilers, and Generators."

Mar. 25. To Jane Bentley Lowry, city of Exeter, straw-hat manufacturer; for "improvements in the manufacture of Hats and Bonnets."

26. To Edward Cowper, of Clapham Road, parish of St Mary, Lambeth, county of Surrey, gentleman; for "improvements in cutting Paper."

To Ferdinand de Tourville, of Piccadilly, London, merchant; for "improvements on Filtering Apparatus."

29. To Thomas Lawes, of the Strand, London, lace manufacturer; for "an improved Thread, to be used in the manufacture of bobinnet lace."

To Henry Marriott, of Fleet Street, city of London, ironmonger, and Augustus Siebe, of Prince's Street, Leicester Square, county of Middlesex, mechanist; for "improvements in Hydraulic Machines."

To Peter Taylor, of Holmwood, in the county of Lancaster, flax-dresser; for "improvements in machinery for Heckling, Dressing, or Combing flax, hemp, tow, and other fibrous materials."

To John Davis, of Lemon Street, Goodman's Fields, county of Middlesex, sugar-refiner; for "improvements in boiling or evaporating solutions of Sugar and other liquids, communicated from abroad."

April 3. To Charles Harsleben, of New Ormond Street, county of Middlesex, Esq.; for "improvements in machinery, to be used in Navigation, chiefly applicable to the propelling of Ships and other floating bodies."

15. To **Samuel Wellman Wright**, of Webber Street, Lambeth, county of Surrey, engineer; for "improvements in the construction of Wheel Carriages; and in the machinery employed for propelling, drawing, or moving wheel-carriages."

19. To **John Gossliteb Ulrich**, of Cornhill, city of London, chronometer maker; for "improvements on Chronometers."

List of Patents granted in Scotland from 23d February to 19th May 1828.

1828,

Mar. 10. To **Paul Steenstrup** of Basing Lane in the city of London, Esq. for "certain improvements in machinery for Propelling Vessels, which improvements are applicable to other purposes."

19. To **John Harvey Sadler** of Hoxton, in the county of Middlesex, merchant, for "certain improvements on Power-Looms for the weaving of silk, cotton, linen, wool, flax and hemp, and all mixtures thereof."

25. To **William Pownall** of Manchester, in the county of Lancaster, weaver, for 'improvements in making Healds for weaving purposes.'

To **Thomas Tyndall** of Birmingham, in the county of Warwick, gentleman, for an invention communicated to him by a foreigner residing abroad, for "the improvement in the manufacture of Buttons, and in the machinery or apparatus for manufacturing the same."

To **John Lee Stevens** of Plymouth, merchant, for "a new or improved method or methods of Propelling Vessels through or on the water, by the aid of steam or other means or power, and which may also be applied to other purposes."

April 3. To **John Levers** of the town of Nottingham, machine-maker, for "certain improvements in machinery for the manufacture of Bobbinnet Lace."

May 6. To **Thomas Botfield** of Hopton Court, in the county of Salop, coal and iron master, for "certain improvements in making iron, or in the method or methods of smelting and making of Iron."

19. To **Count de la Garde** of St James's Square, Pall Mall, in the county of Middlesex, for an invention communicated to him by a certain foreigner residing abroad, "of certain improved machinery for breaking or preparing hemp, flax, and other fibrous materials, which he denominates the "Rural Mechanical Brake."

To **Thomas Killman** of Mill Wall, Poplar, in the county of Middlesex, mast-maker, for "certain improvements in the construction and fastening of made Masts."

To **Edward Cowper** of Clapham Road Place, in the parish of St Mary, Lambeth, in the county of Surrey, gentleman, for "certain improvements in Cutting Paper."

THE

EDINBURGH NEW

PHILOSOPHICAL JOURNAL.

Biographical Memoir of Henry Cavendish, *Esq. F. R. S. &c.*
By Baron Cuvier*.

Among those whom we have been accustomed to celebrate in this assembly, there are but too many who have had to struggle against the obstacles which misfortune opposed to them: He of whom we are now to speak, had the much rarer, and probably much greater merit, of not allowing himself to be overcome by those of prosperity. Neither could his birth, which opened to him an easy path to honours, nor great riches, which came suddenly to lure him to pleasures of all kinds, turn him aside from his object; even applause and distinction had no charms for him; the disinterested love of truth was his only principle of action. But if he made a sacrifice of all that men in general hold dearest, he was recompensed by a magnificence proportionate to the pureness of the sacrifice. All that science revealed to him seems to have something of the sublime and marvellous. He weighed the Earth, prepared the means of navigating the air, despoiled the water of its elementary quality; and these doctrines so new and so much opposed to received opinions, he established by evidence still more astonishing than even their discovery. The memoirs in which they are contained, are so many masterpieces of sagacity and method, perfect in whole as in detail, in which no other hand has ever found any thing to improve, and whose lustre time has but increased; so that there is no temerity in predicting, that he will shed as much lustre on his house as he received from it; and that his researches, which perhaps excited the pity and dislike of some of his relatives, will make his name be transmitted to a period to which his rank and ancestry could scarcely have borne it. The history of thirty centuries, in fact, teaches us very clearly, that great and useful truths are, after all, the only lasting heritage that men can leave.

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* Read to the Institute of France.

Men of this order do not, indeed, require the meed of praise; but it is necessary to point them out as examples; and such will be our object in retracing the life, or rather in presenting an abridged account of the labours, of HENRY CAVENDISH, Esquire, Member of the Royal Society of London, and Foreign Associate of the Institute of France. We say an abridged account of his labours; for he was so happy or so wise, that scarcely any thing else is known of him; and in his history there are no other incidents than discoveries. In the following memoir, let not, therefore, that kind of interest be sought for which arises from singular or varied adventures; but, at the same time, let not the uniformity of his life lead us to regard it with indifference. To be able at once to enlighten his cotemporaries, and gain their love; to possess genius, and to disarm by criticism its virulence; to be rich and honoured, without exciting envy; to retain his powers unimpaired, after the most assiduous labours,—are qualities so rare, as to render it curious to know their details, and study their causes.

Mr Cavendish was born at London, on the 10th October 1731. His father, Lord Charles Cavendish, was a member of the Royal Society, and administrator of the British Museum.

His family, descended from one of the companions of William the Conqueror, is among the most illustrious in Great Britain; it is more than two centuries since it was inscribed in the list of the peerage; and William III. in 1694, gave the title of Duke of Devonshire to its head.

It has been remarked, that in England there are more people of rank who devote themselves to science and literature, than in any other country; and the reason is this, because, from the form of government in that country, birth, and even riches, can only give estimation to those possessed of them, in so far as they are sustained by talent. It is therefore necessary to prepare the young nobility for business by a liberal education; and among so many youths whose minds have been stored with useful knowledge, there are always found some who prefer devoting their energies to the research of eternal truths, than in pursuing interests of the moment. Mr Cavendish, throughout the whole of his life, shewed that this preference was the result of a natural taste; but it was necessary for him that it should be confirmed at an early age by domestic examples. Lord Charles, his father, was also fond of science, and has left good observations in natural philosophy. It is probable that he directed the early studies of his son; although we have no information respecting the method which he followed in educating him, nor even of the first attempt of the young Henry in the career of science. He appeared suddenly in it, but in such a manner, as to shew that it was already familiar to him. The first step which he made, opened up a path before unknown, and gave the signal of a new epoch. We allude to the Memoir on Airs, which he presented to the Royal Society in 1766*; and in which he aimed at nothing less than the establishment of these propositions, till then unheard of: *Air is not an element; there exist several kinds of air essentially different.*

From the time of Van Helmont, philosophers knew that various bodies exhale fluids, which resemble air in their permanent elasticity. Boyle discovered at an early period, that they are unfit for respiration; Hales conceived the means of measuring them; Brownrigg and Venel shewed that the sharp taste of certain mineral waters is owing to them; Black discovered, that it is by their presence that limestone is distinguished from quicklime, and the common alkalies from caustic alkali; lastly, Macbride directed the attention of medical men to them, by employing them against putrefaction. But their various kinds had not been distinguished with sufficient accuracy; it was not generally believed that they were specifically different; and more than one philosopher of celebrity always maintained, that these varieties were nothing but common air altered by the emanations of the bodies which furnished them, although no one was able to point out, with precision, in what these alleged emanations consisted. Mr Cavendish presented his Memoir; and, in a few pages, cleared up the subject. He compared, with each other, the elastic fluids extracted from lime and alkalies, that produced by fermentation and putrefaction, and that which occupies the bottoms of wells, caves, and mines; and shewed that they have all the same properties, and form but one and the same fluid, to which the name of *fixed air* was from that time restricted. He determined the specific weight of this air, and found it always the same, and greater by a third, than that of common air; which accounts for the low position it occupies, and the deleterious effects to which it gives rise in the bottom of cavities. He discovered that this kind of air possesses the property of combining with water, and then dissolving limestone and iron; which explains the effects of incrusting waters, the formation of stalactites, and the presence of iron in mineral springs. Lastly, he asserted, that it is precisely the same air that is developed in the combustion of charcoal, and which renders that substance so dangerous as an article of fuel.

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* Phil. Trans. 1766. P. 141.

His experiments on inflammable air were still newer and more striking. This fluid, which was only known by the explosions sometimes produced by it in mines, had scarcely begun to occupy the attention of philosophers at the time when he undertook its investigation. Treating it in the same manner as the former, he shewed that it is identical, and possesses the same properties, whether it be obtained from the solution of iron, or from that of zinc, or of copper; and of these properties, he more especially pointed out its specific lightness, which is about ten times greater than that of common air; and of which our fellow member, M. Charles, afterwards made such a happy application for rendering the navigation of the air by balloons sure and easy. It may, in fact, be said, that without the discovery of Mr Cavendish, and M. Charles's application of it, that of Mr Montgolfier would scarcely have been practicable, so many dangers and inconveniences did the fire, necessary for keeping the air in his balloons expanded, occasion to the aeronaut.

But Mr Cavendish's investigation was followed by other results, and the importance of his discoveries was soon evinced by their fecundity. The fact once ascertained, that there might exist various elastic fluids, constant in their properties and specifically different in their nature, first gave rise to Priestley's researches, which led to the discovery of two new kinds of those fluids, the phlogisticated and nitrous airs. It was then begun to be seen how far the different kinds of air might exercise their influence upon the phenomena of nature, and how little solidity systems of physics and of chemistry could have, which were formed without any regard to agents so powerful and universal. The intellectual faculties agitated by that impatience of doubt which forms their chief spring, entered into a sort of fermentation, and each endeavoured to supply what he saw to be wanting in these theories. Bergman's introduction of fixed air among the acids, while it simplified chemistry a little, formed but a slight palliative to the radical defect which had been perceived in it. This state of things had existed for seven years, when Lavoisier was struck as with the first dawn of his famous theory. Finding a great quantity of fixed air evolved during the reduction of the metals by charcoal, he concluded that the calcination of these substances was nothing but their combination with fixed air. A year after, Bayen reduced calxes of mercury without charcoal in close vessels, and sapped the chief foundation of the phlogistic theory. Lavoisier then examined the air produced by these reductions without charcoal, and found it respirable; and, about the same time, Priestley discovered that it was precisely the part of the atmosphere necessary at once for respiration and combustion. It was then that Lavoisier made a second step. Respiration, the calcination of metals and combustion, said he, are similar operations, combinations of respirable air; fixed air is the peculiar produce of the combustion of charcoal.

But the phenomena of solutions, the inflammable air which manifests itself in them, were not yet explained. Other six years were required for the accomplishment of this, and it was Mr Cavendish for whom the honour was reserved.

Scheele had observed that, in burning inflammable air, neither fixed nor phlogisticated air was obtained; all seemed to disappear. Macquer, while trying to arrest the vapour arising from this combustion, remarked, with surprise, some moisture on the vessels which he employed; but he went no further. Mr Cavendish, who in some measure introduced inflammable air into chemical experiments, was also the first who announced the great influence which it exerted over the combination of bodies *. Carrying, as in his first investigation, the precision for which he was distinguished, to a subject hitherto but superficially examined, he burnt inflammable air in close vessels by the electric spark, supplying it by degrees with the inflammable air necessary for its combustion. He saw that the former of these airs absorbed a determinate portion of the other, and that the whole resolved itself into a quantity of water equal to the weight of the gases that had disappeared. This great phenomenon, which Mr Cavendish took three years to establish, was announced to the Royal Society on the 14th January 1784. Our fellow member, Count Monge, who had formed the same idea, and made the same experiments as Mr Cavendish, communicated their result about the same time to Lavoisier and M. de La Place.

If the combination of these airs yields water, said M. de la Place, it is because they result from its decomposition. Attempts were therefore made to decompose water in the same manner as it had been composed, and they were successful. These experiments became the key-stone to the arch of his new theory, and explained almost every thing that had previously puzzled him. In fact, water being but a combination of the two airs, wherever it exists, it can furnish them on being decomposed; and wherever they are formed, it may arise from their union.

The solutions of metals were at first deduced from inflammable air; and, by a numerous suite of other consequences, the decomposition of organized beings, and the most complicated transformation of their principles. In a word, the theory of chemistry was henceforth seated on its basis. Thus it may be said that this new theory, which produced so great a revolution in science, owed its origin to a discovery made by Mr Cavendish, and that it was a second discovery of the same philosopher which gave it its final completion. He made a third discovery, which would suffice to immortalize him, had the others

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* Phil. Trans. 1784, Part I. p. 119; Journ. de Phys. 1784, t. xxv. p. 417.

never existed: it was that of the composition of nitrous acid, a substance of great utility in the arts, and very extensively diffused in nature, respecting which, before Mr Cavendish's time, chemists had only vague and hypothetical ideas[*]. Ever since his first experiments on the combustion of inflammable air, he had perceived that nitrous acid was formed, and that it was the more abundant in proportion to the quantity of what was then called dephlogisticated air, and afterwards named azote.

Upon examining the product of the detonation of nitre by charcoal, he found it composed of this same phlogisticated air, and fixed air. Now it was the charcoal that yielded the latter; the former, therefore, could be furnished only by the acid of the nitre. Mr Cavendish quickly proved, by direct experiments, the accuracy of his conjecture. By burning a mixture of respirable air and phlogisticated air, by means of the electric spark, he converted it into nitrous air, which was itself changed into acid by a new addition of respirable air. Thus the elements of nitrous acid were found to be the same as those of the atmosphere, but in different proportions; and from henceforth clear ideas were obtained of the universal, and hitherto incomprehensible, generation of that acid.

The history of this epoch, the most brilliant that chemistry ever had, cannot be read without exciting a sort of enthusiasm. Discoveries seemed to press upon each other. Mr Cavendish, having communicated that which he had just made respecting nitric acid to our fellow-member M. Berthollet, received from him in return, that of the decomposition of ammonia into inflammable air and phlogisticated air. What men and what times must those have been!

Mr Cavendish at length undertook the examination of the atmosphere itself. It produced such varied effects upon living beings, that it was natural to suppose that it must be highly variable in the proportion of its elements. Priestley, who discovered pure or respirable air, had also ascertained the means of estimating the respirability of any given air; all that was for this purpose necessary, was to measure the proportion of it which was absorbed, when it was mixed with nitrous air; but his instruments were still imperfect, notwithstanding the corrections made upon them by Fontana. Mr Cavendish, by a slight difference in the manual process, gave them a very superior precision *, and, having employed them for comparing air taken in different places and at different times, arrived at the unexpected result, that the portion of respirable air is the same everywhere, and that the smells which so perceptibly affect our senses, and the miasmata which so cruelly attack our health, cannot be investigated by any chemical means—a result which, although at first sight almost discouraging, presents an immense perspective to the reflecting mind, and already shews in the distance sciences which have not yet been called into existence, and for which alone is perhaps reserved the secret of those which we possess. M. de Humboldt has confirmed this fact, in the most distant regions, by means of the inflammable air eudiometer. MM. Biot and Gay-Lussac found it not less true in the highest parts of the atmosphere which man has been able to attain by means of the balloon, than in its lowest strata. Thus it was still an agent discovered by Mr Cavendish, that these adventurous philosophers employed to verify another of his discoveries.

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[*] Phil. Trans. 1785; Jour. de Phys. t. xxvii. p. 107.

Such are the labours that have assigned to Mr Cavendish so distinguished a place among the cultivators of chemistry; they occupy but a few pages of print, yet they will survive many large books; but we must not estimate the difficulties which attended them by the space which they fill. To have untied the secret knot that bound together so many complicated phenomena, to have pursued the same principle through so many windings and metamorphoses, and especially to have explained with such precision what had for ages eluded the most expert philosophers was, in a few minutes, rendered evident to every one, could be nothing but the effect of meditations, not only the best directed, but the most obstinately persevering. Mr Cavendish was a living proof of the truth of the adage of one of his most illustrious cotemporaries, that genius is but a greater aptitude for patience; a maxim strictly true, if we add to it, that it must be the patience of a man of intellect.

Another not less valuable quality which he possessed was his severity in the matter of demonstration. Nothing doubtful was

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* Phil. Trans. 1783, Part I. p. 106.

admitted by him, nor could any sophism pass unperceived. His character, in this respect, was such, that his friends hastened to lay their researches before him, assured that if he approved of them, no one could find occasion to contradict them. He treated himself more severely than any other; and thus he was enabled to give his works such a degree of perfection, that even now nothing can be added to them, nor can any alteration be made in them, although the first of them appeared more than forty years ago, and although the science to which they refer has in that interval undergone a complete revolution. They are, perhaps, the only scientific productions in existence that can boast of such a merit. This severity, introduced by Mr Cavendish into chemical inquiries, was as beneficial to the science as his discoveries themselves; for it is to his method that we are, in a great measure, indebted for the discoveries which were made by others. Until about the middle of the eighteenth century, chemistry seemed to have become an asylum for the gratuitous suppositions and baseless theories which Newton had expelled from physics. Cavendish and Bergman pursued them thither; they cleared that Augean stable, still overspread with the rubbish of the hermetical philosophy. Since their time no one has dared to operate but on determinate quantities, and by keeping a strict account of all the kinds of products; and it is this which forms the distinctive character of the modern chemistry, much more than its theories, which, beautiful as they appear to us, will not perhaps be unimpeachable, should the substances, which have hitherto baffled our research, be one day mastered. Mr Cavendish owed this strictness to a profound study of geometry, of which he has also made direct applications, sometimes as happy as his chemical researches. Such, in particular, is his determination of the mean density, or, which comes to the same thing, of the total weight of the globe *; an idea which at first had something frightful in it, but which, nevertheless, reduces itself to a simple law of mechanics. Archimedes asked a point of support for moving the earth, but Mr Cavendish required none for weighing it.

Another member of the Royal Society, who died some time previously, Mr Mitchell, conceived the means of accomplishing

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* Phil. Trans. 1798, Part II. p. 469.

this object, and had constructed, for the purpose, an apparatus which was nearly the same as that already employed by our deceased fellow member M. Coulomb, for measuring the power of electricity, and that of the magnet. A lever, six feet long, bearing at each extremity a small lead ball, was suspended horizontally, by the middle, to a vertical thread. This lever once at rest, a large mass of lead of a given diameter and weight, was brought near each of its extremities in a lateral direction. The attraction, exerted by the masses upon the balls, put the lever in motion. The thread became twisted in accommodating itself to this action, and tending to return to its first state, made the lever describe small horizontal arcs, that is to say, the attraction of the earth made it describe arcs perpendicular to the pendulum; and, by comparing the extent and duration of these oscillations and those of the pendulum, the relation of their causes was obtained, or, in other words, the relation of the attractive power of the masses of lead, and of that of the terrestrial globe. But this presented only a rude idea of the apparatus, and of the precautions and calculations which the experiment required. The mobility of the lever was such, that the slightest difference of heat between the two balls, or only between the different parts of the air, occasioned a current strong enough to make it vibrate. It was even necessary to estimate the attraction of the walls of the wooden case in which it was contained; and the attention required in measuring the extent of its vibrations, and even in observing it without altering them by approaching too near, was almost infinite. All these difficulties became apparent only at the moment of performing the experiment; and the delicate means which procured their removal, and of which the necessity had not even been foreseen by Mitchell, belong entirely to Mr Cavendish. The result was singular; the mean density of the globe was found to be $5.\frac{48}{100}$ times, or something less than 5½ times that of water. According to this result, it would be necessary not only that the globe should have no vacuities in it, but also that the materials of its interior should be heavier than those of the surface; for the substances, of which the common rocks are composed, are only about three, or rarely four, times the weight of water, and no known stone has a specific gravity so high as five. It might therefore be imagined that the metals are more abundant toward the centre. Thus this new experiment furnished quite new views with respect to the theory of the earth. It appeared, at first, to disagree with those made by Maskelyne in Scotland, in which the deviation, produced by the vicinity of a mountain in the plumb-line of his instruments, made him infer a mean density of only four and a half times that of water; but it is asserted, that, after a more accurate calculation of Maskelyne's experiments, their result was found to come very near that obtained by Mr Cavendish.

He was also one of the first who applied calculation to the theory of electricity. His investigation was performed before Æpinus's work on the same subject appeared, but it was not communicated to the public until after. He set out upon the same hypothesis, namely, that there is but one kind of electrical matter, the molecules of which mutually repel each other, and are attracted by other bodies; but Mr Cavendish shews, that, supposing this action to be exercised in a proportion less than the inverse of the cube of the distance, it may be proved, by means of Newton's theory respecting the attraction of a sphere, that all the electrical matter of a body of that form ought to come to its surface *. It is well known that our fellow member the late M. Coulomb, afterwards demonstrated, by direct experiments, that the action of electricity is exercised in the reverse ratio of the square of the distance, and that he proved, in a much more general manner, the necessity of this distribution at the surface of bodies, whatever their figure may be.

When Walsh announced the analogy between the shock which the torpedo gives, and that of the Leyden phial, it was objected that the fish in question does not produce sparks. Mr Cavendish immediately endeavoured to explain the reason of this difference †. He even constructed, after the principle of his explanation, a sort of artificial torpedo, which presented the same phenomena when it was electrified. The true cause of animal electricity, however, escaped him; and it was for M. Volta that it was reserved to discover an apparatus calculated to engender this wonderful fluid without intermission, and to electrify itself incessantly,—an apparatus very probably analogous, in its essence, to those with which nature has supplied the electrical fishes.

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* Phil. Trans. 1771, p. 548.

† Ibid. 1776, p. 196.

It is also known that the same Walsh saw sparks in the electric eel of South America, a fish which possesses that property in a much higher degree than our European torpedoes, and which, according to M. Humboldt, is capable of stunning horses by its shocks.

We have also observations by Mr Cavendish on the height of luminous meteors *, which might have led to the supposition, now so well verified, of the falling of stones from the atmosphere. He wrote a very learned memoir on the means of improving meteorological instruments †, and made ingenious remarks on the effects of frigorific mixtures, and their limits ‡. He even occupied himself with the calendar of the Hindoos, and endeavoured to compare their confused cycles with our mode of reckoning time §. But the limits of a public discourse do not permit us to enter into an analysis of all his writings; we only mention them, to add the example of Mr Cavendish to so many others, which prove that great discoveries are reserved for men habitually given to contemplation.

Toward the end of his life, he busied himself with regulating more accurately the division of the great astronomical instruments; and it was assuredly carrying to the extreme the love of accuracy, to be dissatisfied with the art which, of all others, has carried that quality to the highest pitch.

After this long enumeration of Mr Cavendish's labours, it will readily be comprehended that a life so productive could not have been an agitated one; but what would not so readily occur, was the extreme uniformity of his life, and the scrupulous exactness with which he fulfilled the view which had induced him to devote it to study. The most austere anchorites were not more faithful to theirs. Among the numerous problems which he solved, he placed in the first rank that of not losing a minute or a word; and he found, in fact, so complete a solution of it, that it will astonish those who are most economical of time and words. His people knew from his signs whatever he wanted; and, as he scarcely ever asked any thing from them, this sort of dictionary was but brief. He had only one dress at a time, which was renewed

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* Phil. Trans. 1790, p. 101.

† Ibid. 1776, p. 375.

‡ Ibid. 1783, p. 303, and 1786, p. 241.

§ Ibid. 1792, p. 383.

at fixed periods, the new suit being of the same cloth and colour as the former. Lastly, it has even been said, that, when he went to ride, he had to find his boots always ready in the same place, and the whip placed in one of them, and always in the same one.

The occasion of assisting at some new experiment, or of conversing with some one who might afford him instruction, or had need of his advice, was the only thing capable of interrupting the established order, or rather this sort of interruption itself formed part of his order: then he indulged himself in the pleasure of talking; and his conversation, which was entirely Socratic, did not end until all was cleared up.

In every thing else, his mode of life had all the regularity and precision of his experiments. It could not even be altered by an incident which, of a certainty, would have produced a great change in that of any other. Being a younger member of a younger branch, he was rather poor in his youth, and his parents, it is said, treated him as a man who, to all appearance, would never become rich. Chance or his real merit decided otherwise.

One of his uncles who had served in the army in India, and who had made a great fortune there, conceived a strong attachment for him, and left him the whole. Being now the possessor of many thousands of pounds, Mr Cavendish had to use a few additional signs, to shew what was to be done with the excess of his income; but to obtain them, it was still necessary for him to be repeatedly urged by his banker. It is said that the banker came one day to tell Mr Cavendish that he had allowed L. 75,000 Sterling to accumulate in his hands, and that he was ashamed to keep so large a sum longer, without being regularly settled,—a circumstance which assuredly proves as much delicacy on the one side, as carelessness on the other. It is said, however, that he ultimately left about L. 1,250,000 Sterling. Few philosophers have been so rich, and few rich people have become so like him, without caring about riches. This cause of the greatness of his fortune is also its excuse; for we must allow that one almost needs to be excused when he has acquired so much; yet he did not omit seeking opportunities of diminishing it: he supported and carried forward several young persons who gave promise of talent; he formed a great library, and a very rich natural philosophy cabinet, which he devoted so completely to the use of the public, as to reserve no privileges for himself, borrowing his own books with the same formality as strangers, and, like them, putting his name into the librarian's register. One day the keeper of his instruments told him, with anger, that a young man had broken a very valuable machine. "Young people," he replied, "must break machines to learn how to use them; get another made."

The regularity of Mr Cavendish's life procured him long days exempt from infirmity. To the age of seventy-nine he retained the activity of his body and the powers of his mind. He owed probably to his reserved manners, and the modest tone of his most important writings, another not less great advantage, and one which men of genius seldom enjoy, that of never having his repose disturbed by the jealousy of rivals, or the acrimony of critics. Like Newton, his great countryman, whom he resembled in other respects, he died full of years and of renown, cherished by his cotemporaries, respected by the generation which he had instructed, celebrated among all the learned of Europe, presenting at once to the world the accomplished model of what all men of science ought to be, and an affecting example of the happiness which they ought to enjoy.

His decease took place on the 24th February 1810.

His place in the Institute was given to M. Alexander de Humboldt, whose extensive acquirements, multiplied labours, and adventurous enterprises, which have obtained for him the estimation of the learned of both hemispheres, have long entitled him to this distinction, in the opinion of all who have a right to form one on such a subject.

Essay on the Structure and Action of Volcanoes in different regions of the Earth. By Baron HUMBOLDT *.

WHEN we reflect upon the influence which, for many ages, has been exercised upon the study of nature, by the improvements of geography, and by scientific journeys made into distant regions, we quickly perceive how different this influence has been, according as the researches have been directed toward the forms of the organic world, or toward the inanimate mass of the earth. Different forms of plants and animals enliven the earth's surface in each zone, however much the heat of the atmosphere may change, whether according to the geographical latitude, or the numerous curves of the isothermal lines, in the extended plains, level as the surface of the sea, or in an almost vertical direction on the steep slopes of the mountain chains. Organic nature gives to each region of the earth the peculiar physiognomy by which it is distinguished. The case is different with inorganic nature in the places where the solid envelope of the earth is deprived of vegetation. The same species of rocks, attracting and repelling each other by groups, disclose themselves in the two hemispheres, from the equator to the poles. In a distant isle, surrounded by unknown plants, in a clime where the stars to which his eye is habituated no longer shine, the voyager often recognises with joy the granite of his native country, and the rocks which he has been accustomed to see.

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* Translated from the Tableaux de la Nature, par Humboldt, t. ii.

This independence upon the present constitution of climates, which is peculiar to inorganic nature, does not diminish the beneficial influence which numerous observations, made in distant countries, have upon the progress of geognosy; it only gives them a particular direction. Each succeeding expedition enriches natural history with new species of animals and plants. Sometimes organic forms are discovered which connect themselves with types long known, and which present in its original perfection the regularly woven, and often apparently interrupted, net-work of animated natural forms. Sometimes the discoveries consist of forms which present themselves isolated, like the remains of extinct races; sometimes of members of yet unknown groups. The examination of the solid crust of the earth exhibits no such diversity. On the contrary, it discloses, in the constituent parts, in the relative position, and in the periodical recurrence of the different masses, a similarity which strikes the geologist with astonishment. In the chain of the Andes, as in the central mountains of Europe, one formation seems, as it were, to recal another. Masses of the same name assume similar forms; the basalt and greenstone form twin mountains; dolomite, white sandstone and porphyry, form masses broken into cliffs; trachyte, rich in vitreous felspar, rises into domes. In the most distant zones, large crystals separate similarly, as by an internal development, from the compact texture of the primitive mass, form themselves into groups, appear as subordinate masses, and often announce the vicinity of independent new formations. In this manner the whole inorganic world is evidently pictured in every mountain chain of any extent. To become perfectly acquainted, however, with the most important phenomena of the composition, relative age, and origin of the formations, it is necessary to compare, with each other, observations made in countries the most widely separated, problems which have long seemed enigmatical to geologists living in the north, find their solution near the equator. If, as has been observed, the distant zones do not furnish us with new formations, that is to say, unknown groups of simple substances, they yet enable us to understand the uniform laws of nature, by which the various strata support each other, penetrate into each other's substance in the form of veins, or raise each other in obedience to elastic powers.

If it be true that our geognostical knowledge derives the greatest advantage from researches made over vast expanses of country, it ought not to excite surprise that the class of phenomena which forms the principal object of this memoir should, till lately, have been examined in a very imperfect manner, because the points of comparison are very difficult, and may even be said laborious, to find. Until the end of the eighteenth century, all that was known of the form of volcanoes, and of the action of their subterranean powers, was derived from two mountains in the south of Italy, Vesuvius and Etna. The former being the most accessible, and, like all volcanoes of inferior elevation, having more frequent eruptions, a small hill became, in some measure, the type according to which a whole distant world was represented, containing the great volcanoes of Mexico, South America, and the Asiatic Isles. This mode of reasoning might naturally bring to our recollection Virgil's shepherd, who, in his humble cabin, imagined he saw the image of the *eternal city*.

An attentive examination of the whole Mediterranean, especially its islands and eastern shores, where the human race has begun to rise in the progress of intellect, and in the cultivation of generous feelings, might, however, reform this imperfect manner of studying nature. Among the Sporades, trachyte rocks have risen from the bottom of the sea, and formed islands, like that among the Azores, which, in the space of three centuries, has shewn itself at nearly equal intervals. Between Epidaurus and Trèzéne, near Methone, in the Peleponnesus, there occurs a Monte Nuovo, which was described by Strabo, and has been seen again by Dodwell. It is higher than the Monte Nuovo of the Phlegrean Fields, near Baiæ, perhaps even higher than the new Volcano of Jorullo, in the Plains of Mexico, which I found surrounded with many thousands of small basaltic cones, that had issued from the ground, and were still smoking. In the basin of the Mediterranean, not only does the volcanic fire escape from permanent craters of isolated mountains, which have a constant communication with the interior of the earth, as Stromboli, Vesuvius, and Etna; but at Ischia, on Mount Epomée; and, according to the accounts of the ancients, in the Plains of Lelantis, near Chalcis, lavas have flowed from fissures which have suddenly opened at the surface of the ground.

Independently of these phenomena which belong to historical times, to the limited domain of sure tradition, the shores of the Mediterranean contain numerous remains of more ancient effects of the action of fire. The south of France, in Auvergne, displays a particular and entire system of volcanoes, arranged in series, of trachytic domes, alternating with cones perforated with craters, from which torrents of lava have flowed in narrow stripes. The Plain of Lombardy, which, smooth as the surface of the waters, forms the most remote gulf of the Adriatic Sea, surrounds the trachyte of the Euganean Hills, in which there rise domes of granular trachyte, obsidian, and perlite, forming three masses proceeding from each other, which have forced their way through the Juraic limestone, filled with flints, but which have never run in narrow torrents. Similar evidences of ancient revolutions of the earth occur in various parts of the Continent of Greece and of Asia Minor, a country which will one day present rich materials for geological research, when light shall have returned to those countries whence it began to shine on the west, when outraged humanity shall no longer groan beneath the savage barbarity of the Ottomans.

I bring forward the geographical proximity of these numerous phenomena, to shew that the basin of the Mediterranean, with its islands, is capable of presenting to the attentive observer all that has recently been discovered, under various forms, in South America, in Teneriffe, or in the Aleutian Isles, in the vicinity of the polar regions. The objects to be observed were united together; but travels into distant regions, and comparisons of extensive countries in Europe and out of it, were necessary for clearly shewing the mutual resemblance of volcanic phenomena, and their dependence upon one another.

Common language, which often gives consistency and duration to ideas arising from the most erroneous views of things, but which also frequently indicates the truth instinctively, gives the name of Volcanic to all the eruptions of subterranean fires and melted substances; to the columns of smoke and vapour which issue from the heart of rocks, as at Colares, after the great earthquake at Lisbon; to the salses or cones of clay which vomit mud, asphaltes, and hydrogen, as at Girgenti, in Sicily, and at Turbaco, in South America; to the hot springs of the Geyser, which, impelled by elastic vapours, rise to an immense height; in a word, to all the effects of the mighty powers of nature, which have their seat in the interior of our planet. In central America, or in the country of Guatemala, and in the Philippine Isles, the natives make an essential difference between water volcanoes and fire volcanoes (*volcanes de agua y de fuego*). By the former name they designate the mountains, from which, amid violent earthquakes, subterranean waters issue from time to time.

Without denying the connection of the phenomena just mentioned, it would yet appear expedient to give a more precise language to the physical and oryctognostical department of geognosy, in order to prevent the application of the name of Volcano, sometimes to a mountain which is terminated by a permanent furnace, and sometimes to each subterranean cause of volcanic phenomena. In the present state of the terrestrial globe, the most common form of volcanoes, in all parts of the world, is that of an isolated cone, such as Vesuvius, Etna, the Peak of

Teyde, Tunguragua, and Cotopaxi. I have observed them rising from the size of the lowest hills to 17,700 feet above the level of the sea. But close to these conical mountains, there also occur permanent apertures, forming regular communications with the interior of the earth, on long serrated chains, not at the middle of their mural summit, but at their extremity, and near the declivity. Of this kind is Pichincha, which rises between the great ocean and the city of Quito, and which Bouguer's barometrical formulæ have long rendered celebrated. Such also are the volcanoes which rise on the Steppe de los Pastos, which is 10,000 feet high. All these summits, of varied forms, are composed of trachyte, formerly named trap porphyry, a granular fissured rock, formed of glassy felspar and hornblende, and in which augite, mica, laminar felspar, and quartz, also occur. In places where the evidences of the first eruption I might say of the ancient volcanic scaffolding, are preserved entire, the isolated conical mountain is surrounded, in the form of an amphitheatre, with a great wall, constructed of rocky strata, superimposed upon each other. These walls or circumvallations are the remains of *craters of elevation*, a phenomenon worthy of attention, respecting which the first geologist of our times, M. Leopold Von Buch, in his writings, from which I have borrowed several ideas stated in the present memoir, has presented such interesting views.

The volcanoes which communicate with the atmosphere by permanent apertures, the basaltic cones or domes of trachyte, destitute of crater, sometimes low like Sarcouy, and sometimes elevated like Chimborazo, form various groups. Comparative geography shews us, on the one hand, small archipelagoes, and entire systems of volcanic mountains, with their craters and currents of lava, resembling those of the Canary Islands, and the Azores; and, on the other, mountains without craters, and without currents of lava, properly so called, as the Euganeans, and the (Siebengebirge) seven mountains of Bonn. Moreover, it shews us volcanoes arranged in single or double lines, and extending to several hundreds of leagues, sometimes parallel to the axis of the chain, as in Guatemala, Peru, and Java; sometimes cutting it perpendicularly, as in the country of the Azteques, where trachytic mountains, which vomit fire, alone attain the height of perpetual snow, and are probably situated upon a crevice traversing the whole continent, over an extent of 105 geographical leagues from the Pacific Ocean to the Atlantic.

This association of volcanoes, whether in isolated and rounded groups, or in longitudinal bands, demonstrates, in the most decisive manner, that volcanic effects do not depend upon slight causes existing near the surface of the earth, but are phenomena whose origin is to be found at a great depth in the interior of the globe. The whole eastern part of the American continent, which is poor in metals, is, in its present state, destitute of volcanic mountains, of masses of trachyte, and probably even basalt, with olivine. All the American volcanoes are collected together in the chain of the Andes, which is situated in the part of that continent opposite to Asia, and which extends, in the direction of the meridians, over a space of 1800 leagues. The whole plain of Quito, of which Pichincha, Cotopaxi, and Tunguraqua form the cymes, is a volcanic focus. The subterranean fire escapes, sometimes by one, sometimes by another, of those apertures which it has been customary to consider as distinct volcanoes. The progressive march of the fire in them has, for the last three centuries, been from north to south. The very earthquakes, which produce such terrible ravages in this part of the world, afford remarkable proofs of the existence of subterranean communications, not only with countries destitute of volcanoes, which has been long known, but also between ignivomous mountains placed at very great distances from each other. Thus, in 1797, the volcano of Pasto, to the east of the course of the Guaytara, vomited, unremittingly, for three months, a high column of smoke. This column disappeared at the very moment, when, at a distance of sixty leagues, the great earthquake of Riobamba, and the muddy eruption of Moya, destroyed about forty thousand Indians. The sudden appearance of the Island of Sabrina, to the east of the Azores, on the 30th January 1811, was announced by the dreadful earthquake, which, at a much greater distance to the west, from May 1811 to June 1812, shook, almost without intermission, first the West India Islands, then the plains of the Ohio and Missisippi, and, lastly, the coasts of Venezuela, situated on the opposite side. Thirty days after the total destruction of the city of Caraccas, the explosion of the volcano of St Vincent, in the Lesser Antilles, took place at a distance of 130 leagues. At the same moment when this eruption happened, on the 30th April 1811, a subterranean noise was propagated, and carried terror over an extent of country of 2200 square leagues. The inhabitants of the banks of the Apuré, at the confluence of the Rio Nula, as well as those of the sea coast, compared the noise to that produced by the discharge of large pieces of artillery. Now, from the confluence of the Rio Nula and Apure, by which I arrived at the Oronocco, to the volcano of St Vincent, the distance is 157 leagues in a straight line. This noise, which assuredly was not propagated by the air, must have had its cause deep in the earth. Its intensity was scarcely greater on the shores of the Antilles, near the volcano in action, than in the interior of the country.

It would be useless to multiply examples; but in order to recall to mind a phenomenon which has acquired a historical importance with reference to Europe, I shall now mention the famous earthquake of Lisbon. It took place on the 1st November 1755. Not only were the waters of the Swiss Lakes, and of the sea on the coasts of Sweden, violently agitated; but also those of the sea around the eastern Antilles. At Martinique, Antigua, and Barbadoes, where the tide does not commonly rise more than eighteen inches, it suddenly rose twenty feet. All these phenomena prove, that the subterranean powers manifest themselves, either dynamically, by earthquakes, or chemically, by occasioning changes in the form of volcanic eruptions. They also demonstrate, that these powers act, not superficially in the outer crust of the earth, but at immense depths in the interior of our planet, by crevices and unfilled veins, which lead to points of the earth's surface, at the greatest distances from each other.

The more numerous the diversities in the structure of volcanoes, or in other words, of the elevations surrounding the canals by which the melted masses of the interior of the globe arrive at its surface, so much the more important is it to submit this structure to accurate measurements. The interest of these measurements, which, in another part of the world, have formed the object of my researches, increases if we consider that the magnitude to be measured varies in several points. The philosophical examination of nature applies itself, in the vicissitude of phenomena, to connect the present with the past. To establish a periodical return, or to fix the laws of progressive and variable phenomena, it is necessary to have some well determined points of departure, observations made with care, and which, being connected with determined epochs, may furnish numerical comparisons. Had only the mean temperature of the atmosphere, and of the earth in different latitudes, or the mean temperature of the barometer on the edge of the sea, been determined from one century to another, we should have known in what proportion the heat of climates has increased or diminished, and whether or not the height of the atmosphere has undergone changes. These points of comparison are required for the declination and inclination of the magnetic needle, as well as for the intensity of the electro-magnetic forces. If it be a praiseworthy occupation for societies to follow, with assiduity, the cosmic vicissitudes of heat, of the pressure of the air, and of the magnetic direction and intensity; it is, on the other hand, the duty of the geologist, in determining the inequalities of the earth's surface, to take into consideration the change of height of volcanoes. What I attempted at the time, in the mountains of Mexico, at Toluca, Nauhamputeptel and Jorullo, and in the Andes of Quito at Pichincha, I have had an opportunity, since my return to Europe, of repeating several times at Vesuvius.

In 1773, Saussure measured that mountain at a period when the two edges of the crater, the north-west and south-west, appeared to him of equal height. He found their elevation 609 toises above the level of the sea. The eruption of 1794 occasioned a falling in of the southern part, and an inequality of the edges of the crater which the most inexperienced eye distinguishes at a considerable distance. In 1805, M. von Buch, M. Gay Lussac and myself, measured Vesuvius three times. The result of our operations was, that the height of the north edge, the Rocca del Palo, which is opposite the Somma, agreed with Saussure's measurement, but that the south edge was 75 toises lower than in 1773. The total elevation of the volcano, towards the Torre del Greco, the side towards which the fire had principally directed its action for thirty years, had diminished an eighth part. The cone of ashes is, to the total height of the mountain, on Vesuvius, as one to ten; on the Peak of Teneriffe as one to twenty-two. Vesuvius, therefore, has the cone of ashes proportionally higher, probably because, as a volcano of little height, it has acted principally by its summit. I succeeded lately not only in repeating my barometrical measurements on Vesuvius, but also in ascending that mountain three times, in order to take a complete survey of all the edges of the crater. This undertaking is perhaps deserving of some interest, because it embraces the period of the great eruptions from 1805 to 1822; and because it affords, perhaps, the only measurement of the volcano, made with reference to all its parts, that has hitherto been published. It shews that the edges of the crater, not only in the places where they are visibly composed of trachyte, as in the Peak of Teneriffe, and in all the volcanoes of the chain of the Andes, but also every where else, present a phenomenon much more constant than had previously been supposed from observations hastily made. Simple angles of height, determined from the same point, answer much better for researches of this kind than trigonometrical and barometrical measurements, otherwise very complete. According to my last determination, the northwest edge of Vesuvius has not perhaps undergone any diminution of height since the time of Saussure, that is to say for the last forty-nine years, and the south-east edge, on the Bosche Tre-Case side, which, in 1794, was 400 feet lower than the preceding, has undergone a diminution of 10 toises.

If the public journals, in describing the great eruptions, very frequently relate that the form of Vesuvius has totally changed, and if these assertions are confirmed by the picturesque views of that mountain which are painted at Naples, the cause of error exists in the circumstance that the contour of the edges of the crater is confounded with those of the heaps of scoriæ which are accidentally formed in the centre of the crater, on the bottom of the ignivomous mouth raised up by vapours. One of these heaps, consisting of rapilli and scoriæ, became gradually visible in 1816 and 1818, above the south-east edge of the crater. The eruption of February 1822 increased it to such a degree, that it even exceeded the Rocca del Palo, or the northwest edge of the crater, by 100 or 110 feet. In the last eruption, the remarkable cone, which was usually considered as the true summit of Vesuvius, fell down with a terrible noise, so that the bottom of the crater, which, since 1811, was always accessible, is now 750 feet lower than the northern edge of the volcano, and 200 feet lower than the southern. The variable form and relative position of the cones of eruption, whose aperture ought not, as is too often done, to be confounded with the crater of the volcano, give a particular aspect to Vesuvius at different periods, and the historiographer of this volcano might, from the contours of the summit, and from the simple inspection of the landscapes painted by Hackert, which are at Portici, according as the northern or southern side of the mountain is represented higher or lower, guess the year in which the artist made the drawing from which he composed his picture.

A day after the cone of scoriæ, 400 feet high, had fallen in, when already small but numerous torrents of lava had flowed, in the night of the 23d October, commenced the luminous eruption of ashes and rapilli. It lasted twelve days without interruption; but it was more intense during the first four. All this time, the detonations in the interior of the volcano were so violent, that the mere concussion of the air (for no commotion was observed in the earth), cracked the ceilings of the apartments in the palace of Portici. The villages of Resina, Torre-del-Greco, Torre del Anunziata, and Bosche-Tre-Case, which are close upon the mountain, witnessed a remarkable phenomenon. The atmosphere was so filled with ashes, that the whole district was for several hours in the middle of the day enveloped in profound darkness. People used lanterns in the streets, as often happens at Quito, during the eruptions of Pichincha. The inhabitants never fled in such numbers. The torrents of lava were much less dreaded than an eruption of ashes,—a phenomenon which had not before been known to such a degree, and which, from the obscure tradition of the manner in which Herculaneum, Pompeii and Stabiæ were destroyed, filled the imagination of men with terrifying images.

The watery and hot vapour which shot up from the crater during the eruption, and diffused itself in the atmosphere, formed, on cooling, a thick cloud round the column of ashes and flame which rose to the height of 9000 feet. So rapid a condensation of the vapours, and, as M. Gay Lussac has shewn, the very formation of the cloud, augmented the electrical intensity.

Flashes issued from the column of ashes in all directions, and the thunder, which was easily distinguished from the noises of the volcano, was distinctly heard. In no other eruption was the manifestation of the electric powers so astonishing.

On the morning of the 26th October, a surprising noise was heard, which seemed to arise from a torrent of boiling water that was ejected from the crater, and descended along the declivity of the cone of the ashes. Monticelli, the learned and zealous observer of the volcano, immediately discovered that an optical illusion had occasioned this erroneous rumour. The supposed torrent was a great heap of dry ashes, which issued from a crevice in the upper edge of the crater. A drought which spread desolation in the fields, had preceded the eruption of Vesuvius. Toward the end of this phenomenon, the volcanic thunder storm which we have just been describing, occasioned an extremely heavy and long continued rain. In all countries, the cessation of an eruption is characterized by a similar meteor. So long as the present one lasted, the cone of ashes being generally enveloped with clouds, and the rain being heaviest in its vicinity, torrents of mud were seen flowing on all sides. The affrighted husbandman thought it was water, that, after ascending from the bottom of the volcano, issued by the crater. The geologist thought he discovered in it sea water, or muddy productions of the volcano, or, to use the expression of the French old systematic writers, products of an igno-aqueous liquefaction.

When the summit of the volcano, as is almost always the case in the Andes, rises above the region of snow, or attains a height double that of Etna, the snow, by melting and flowing toward the lower regions, produces frequent and disastrous inundations. These are phenomena which the meteors connect with the eruptions of volcanoes, and which are variously modified by the height of the mountain, the extent of its summit covered with perpetual snows, and the heating of the walls of the cone of cinders. They cannot at all be regarded as true volcanic phenomena, being merely the effects of such phenomena. In vast cavities, sometimes on the declivity, sometimes at the foot of volcanoes, are found subterranean lakes which communicate in various ways with the alpine torrents. When the commotions of the earth which always precede all the igneous eruptions in the chain of the Andes, have violently shaken the whole mass of the volcano, then the subterranean gulfs open, and there issue at the same time water, fishes, and clay tufa. Such is the singular phenomenon which brings to light the *Pimelodes cyclopum*, a fish to which the inhabitants of the plain of Quito gave the name of *Prenadilla*, and which I described shortly after my return. When to the north of Chimborazo, in the night of the 19th June 1698, the summit of Carguaraizo, a mountain of the height of 18,000 feet, broke down, the whole country round, to the extent of nearly two square leaguges, was covered with mud and fishes. Seven years before, a pernicious fever, which desolated the city of Iburra, was attributed to a similar eruption of fishes from the volcano of Imbaburu.

I mention these facts, because they throw some light on the difference which exists between the eruptions of dry ashes and those of mud, wood, charcoal, or shells, serving to explain the formation of tufa and trass. The quantity of ashes thrown out by Vesuvius of late years, like all the circumstances connected with volcanoes, and other great phenomena of nature calculated to inspire terror, has been excessively exaggerated in the public journals. Two chemists of Naples, Vicenzo Pepe and Giuseppe di Nobili, have even affirmed, notwithstanding the contrary assertions of Monticelli and Covelli, that the ashes contain gold and silver. According to my inquiries, the bed of ashes that fell during twelve days on the Bosch-Tre-Case side, on the declivity of the cone, in the places where rapillo was mingled with them, was only three feet deep, and in the plain, did not rise higher than from fifteen to eighteen inches. Measurements of this kind should not be taken in places where the ashes are heaped up, like snow or sand, by the wind, or accumulated by water in the form of mud. The times are gone when wonders only were looked for in volcanic phenomena, or when the ashes of Etna were represented as being carried by the winds as far as the peninsula of India. Some of the gold and silver veins of Mexico certainly occur in a trachytic porphyry; but the ashes of Vesuvius, which I carried along with me, and which were analysed by an excellent chemist M. Henry Rose, afford not the slightest traces of gold or silver.

Although the results of which I speak, and which are in perfect accordance with the accurate observations of Monticelli, differ much from those published some months ago, the eruption of ashes from Vesuvius which took place on the 24th and 28th of October 1822, is undoubtedly the most remarkable of which we have any authentic accounts since the death of the elder Pliny in the year 70. The quantity of ashes which then fell was perhaps three times as great as any that has been observed since volcanic phenomena first began to be studied with attention. A layer of fifty or eighty inches appears at first sight insignificant in comparison of the mass which covered Pompeii; but, without speaking of torrents of rain, and of the effects of detrition, which, in the course of ages, may have accumulated this mass, and without reviving the keen discussion which arose beyond the Alps, and which was conducted with a great degree of scepticism, respecting the causes of the destruction of the cities of Campania, it is perhaps to the purpose to mention here, that the eruptions of a volcano at periods very remote from each other, can by no means be compared together with reference to their intensity. All the consequences founded upon analogies are insufficient, when the objects to be compared are such as the mass of lava and cinders, the height of the columns of smoke, and the loudness of the detonations.

The geographical description of Vesuvius by Strabo, and Vitruvius's opinion respecting the volcanic origin of pumice, shew, that, until the year of Vespasian's death, that is to say, until the eruption which overwhelmed Pompeii, that mountain resembled more an extinct volcano than a solfaterra. After a long repose, the subterranean forces opened up new paths, and penetrated through the strata of primitive rocks and trachyte. Then must have been manifested effects of which those that have since followed could furnish no idea. The celebrated letter, in which the younger Pliny relates to Tacitus the death of his uncle, clearly shews that the renewal of the eruptions, and it might even be said the awakening of the dormant volcano, commenced with an explosion of ashes. The same thing was observed at Jorullo, when, in September 1759, the new volcano, piercing through the strata of syenite and trachyte, rose suddenly in the plain. The country people fled, because they found on their huts ashes which the earth had vomited by opening up on all sides. On the contrary, in the periodical and ordinary explosions of volcanoes, the ashes terminate each partial eruption. Besides, the younger Pliny's letter contains a passage, which clearly shews, that, from the commencement, without the influence of any cause that could have heaped them up, the dry ashes that fell directly from above, had attained a height of four or five feet. "The court," says he in the course of his narrative, which had to be passed in order to enter the chamber in which Pliny reposed, "was so filled with ashes and pumice, that, if he had delayed his coming out any longer, he would have found the entrance shut up." In an inclosed space, like that of a court, the action of the wind, by which the ashes are collected, could not by any means have been very considerable.

I have ventured to interrupt my comparative examination of volcanoes by particular observations made on Vesuvius, both on account of the great interest which the last eruption has excited, and on account of the remembrance of the catastrophe of Pompeii and Herculaneum, which every considerable fall of ashes involuntarily brings to the mind. I have brought together, in a supplement, all the elements of the barometrical measurements and notices respecting geological collections that I have had an opportunity of making, towards the end of 1822, at Vesuvius and in the Phlegrean fields, near Pouzzuolo. This small collection, together with the rocks which I brought from the Euganean mountains, and those which M. von Buch collected on a journey to the valley of Flemme, between Cavalese and Predazzo, in the southern Tyrol, are deposited in the Royal Museum of Berlin, an establishment which, by its utility, perfectly corresponds to the noble intentions of the monarch, and of which, the geognostical department, containing specimens from the most remote regions, is, in this respect, superior to any collection of this kind in existence.

We have been considering the form and action of those volcanoes which keep up a regular communication with the interior of the earth, by means of craters. Their summits are masses of trachyte and lava, raised up by elastic powers, and traversed by veins. The permanence of their action gives rise to the conclusion, that their structure is very complicated. They have, so to speak, an individual character, which remains always the same through long periods. The neighbouring mountains most commonly afford entirely different products, lavas of leucite and felspar, obsidian and pumice, and basaltic masses containing olivine. They belong to the most recent formations of the globe, and traverse nearly all the strata of the secondary mountains. Their eruptions and their torrents of lava are of a more recent origin than our valleys. Their life, if we may be permitted to make use of such an expression, depends upon the mode and duration of their communication with the interior of the earth. They frequently remain quiet for ages, suddenly kindle again, and end with being solfaterras, exhaling aqueous vapours, gases and acids. Sometimes, as in the Peak of Teneriffe, their summit has already become a laboratory of regenerated sulphur; while from their sides there yet flow great torrents of lava, basaltic and lithoid in their lower parts, vitreous, in the form of obsidian and pumice, in their upper part, where the pressure is less.

Independently of these volcanoes provided with permanent craters, there is another species of volcanic phenomena, which is more rarely observed, but which is peculiarly calculated to throw light on geology, because it recalls the primitive world; or, in other words, the most ancient revolutions of our globe. Mountains of trachyte, opening of a sudden, vomit forth lava and ashes, and again shut perhaps for ever. This is what took place in the gigantic Antisana, in the Chain of the Andes, and at Mount Epomeus in the island of Ischia, in 1302. An eruption of this kind sometimes takes place in the plains; for example, on the plain of Quito; in Iceland, at a distance from Hecla; in Eubeus, in the fields of Lelantée. Many islands, suddenly elevated from the bottom of the sea, belong to these transitory phenomena. In these cases, the communication with the interior of the earth is not permanent; the action ceases as soon as the aperture of the canal of communication is closed anew. Veins of basalt, greenstone, and porphyry, which in the different zones of the earth traverse almost all the formations, masses of syenite, augite, porphyry and amygdaloid, which characterize the newest strata of the transition, and the oldest strata of the secondary rocks, have probably been formed in this manner.

In the early stages of our planet, the substances of the interior, still in a state of fluidity, penetrated through the envelope of the earth which was fissured in all parts; sometimes condensing as masses of veins with a granulated texture, sometimes spreading out into sheets and stratified torrents. The volcanic rocks which the primitive world has transmitted to us, have nowhere flowed in narrow bands like the lavas that issue from the volcanic cones existing at present. The mixtures of augite, titanitic iron, glassy felspar, and hornblende, may have been the same at different periods, sometimes more allied to basalt, and sometimes to trachyte. The chemical substances, as we learn from the important labours of M. Mitscherlich, and the similarity of the products of high furnaces, may have been united under a crystalline form, according to definite proportions. It is not the less true, that substances, composed in the same manner, have arrived by very different ways at the earth's surface, whether by being raised up by elastic forces, or by being insinuated through crevices into the strata of the older rocks; in other words, through the already oxidized envelope of our planet, or by issuing under the form of lava from conical mountains, which have a permanent crater. If phenomena so different as these be confounded together, the geognosy of volcanoes is thrown back into the darkness, from which numerous comparative experiments have begun gradually to rescue it.

The question has often been asked, What is it that burns in volcanoes? What is it that produces the heat in them by which the earth and metals are melted and intermingled? The new chemistry replies: What burns is the earth, the metals, and even the alkalies, that is to say, the metaloids of these substances. The already oxidized envelope of the earth separates the atmosphere, rich in oxygen, from the unoxidised inflammable principles which reside in the interior of our planet. Observations made in all countries, in mines, and caves, and which, in concert with M. Arago, I have detailed in a memoir on the subject, prove that, even at a small depth, the earth's heat is much superior to the mean temperature of the surrounding atmosphere. A fact so remarkable, and elicited from observations made in almost every part of the globe, connects itself with what we learn from the phenomena of volcanoes. La Place has even attempted to determine the depth at which the earth may be considered as a melted mass. Whatever doubts may be entertained, notwithstanding the respect due to so great a name, as to the numerical accuracy of such a calculation, it is not the less probable, that all volcanic phenomena arise from a single cause, which is the communication, constant or interrupted, that exists between the interior of our planet and the external atmosphere. Elastic vapours, by their pressure, raise through deep crevices the substances which are in a state of fusion, and which are oxidized. Volcanoes are, so to speak, intermittent springs of earthy matters. The fluid mixtures of metals, alkalies and earths, which condense into currents of lava, flow gently and slowly, when, on being raised up, they once find an issue. It was in this manner that, according to Plato's *Phædos*, the ancients represented all the torrents of fire as emanations of the Pyriphlegeton.

To these considerations may I be permitted to add another of a bolder character. It is perhaps in the internal heat of the earth, a heat which is indicated by experiments made with the thermometer, and the phenomena of volcanoes, that the cause of one of the most astonishing phenomena which the knowledge of petrifactions presents to us resides. Tropical forms of animals, arborescent ferns, palms and bamboos, occur imbedded in the frozen regions of the north. The primitive world every where discloses to us a distribution of organic forms, which is in opposition to the presently existing state of climates. To solve so important a problem, recourse has been had to a great number of hypotheses, such as the approach of a comet, the change of obliquity of the ecliptic, the increase of intensity of the solar heat. None of these hypotheses has been able to satisfy at the same time the astronomer, the natural philosopher and the geologist. As to my own opinion on the subject, I leave the earth's axis in its position, I admit no change in the radiation of the solar disk, a change by which a celebrated astronomer thought he could explain the good and bad harvests of our fields; but I imagine that in each planet, independently of its relations to a central body, and independently of its astronomical position, there exist numerous causes of developement of heat, whether by the chemical processes of oxidation, or by the precipitation and changes of capacity of bodies, or by the augmentation of the electro-magnetic intensity, or the communication between the internal and external parts of the globe.

When, in the primitive world, the deeply fissured crust of the earth exhaled heat by these apertures, perhaps during many centuries, palms, arborescent ferns, and the animals of warm climates, lived in vast expanses of country. According to this system of things, which I have already indicated in my work entitled *Essai Geognostique sur le Gisement des Roches dans les deux Hemispheres*, the temperature of volcanoes is the same as that of the interior of the earth, and the same cause which now produces such frightful ravages, would formerly have made the richest vegetation to spring in every zone, from the newly oxidised envelope of the earth, and from the deeply fissured strata of rocks.

If, in order to account for the distribution of the tropical forms that occur buried in the northern regions of the globe, it is assumed that elephants covered with long hair, now immersed in the polar ice, were originally natives of those climates, and that forms resembling the same principal type, such as that of lions and lynxes, may have lived at the same time in very different climates, such a mode of explanation would yet be inapplicable to the vegetable productions. For reasons which vegetable physiology discloses, palms, bananas, and arborescent monocotyledonous plants, are unable to support the cold of the northern countries; and in the geognostical problem which we are here examining, it appears to me difficult to separate the plants from the animals; the same explanation ought to embrace the two forms.

At the end of this memoir, I have added to the facts collected in countries the most remote from each other, some purely hypothetical suppositions *. The philosophical study of nature rises above the wants of descriptive natural history; it does not consist of the mere accumulation of isolated observations. May it one day be permitted to the curious and active mind of man, to dart from the present into the future, to interpret what cannot yet be known with precision, and amuse itself with the geognostical fables of antiquity, which are in our days reproduced under various forms.

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* The facts alluded to do not appear in the Appendix to the Memoir.

On the Aurora Borealis. By JOHN RICHARDSON, M. D., F. R. S., F. L. S., M. W. S. *Surgeon and Naturalist to the Arctic Land Expedition.*[*]

THE results of the observations of this phenomenon made during the present expedition, coinciding with the remarks on the same subject, given at much length in the Appendix to my former Narrative, I shall here confine myself to the mention of a few brief deductions from a careful examination of our registers at Bear Lake.

The observations were made without intermission for six successive months, in the years 1825–6, and again in 1826–7.

My opinion, recorded in my former Narrative[†], that the different positions of the Aurora have a considerable influence upon the direction of the magnetic needle, has been repeatedly confirmed during our residence at Bear Lake. It was also remarked, that, from whatever point the flow of light, or, in other words, the motion of the aurora proceeded, if that motion was rapid, the nearest end of the needle was drawn towards that point, almost simultaneously with the commencement of the motion.

A careful review of the daily registers of the appearance of the aurora has led me to form the following general conclusions: *1st*, That brilliant and active corruscations of the aurora borealis cause a deflection of the needle almost invariably, if they appear through a hazy atmosphere, and if the prismatic colours are exhibited in the beams or arches. When, on the contrary, the atmosphere is clear, and the aurora presents a steady dense light, of a yellow colour, and without motion, the needle is often unaffected by its appearance.

2d, That the aurora is generally most active when it seems to have emerged from a cloud near the earth.

3d, When the aurora is very active, a haziness is very generally perceptible about the corruscations, though the other parts of the sky may be free from haze or cloud.

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[*] The disturbing effects of the Aurora Borealis on the Magnetic Needle having been denied in some late publications, we now lay before our readers, from Franklin and Richardson's interesting work, observations by Dr Richardson, which prove the powerful effect of the Polar Lights on the Magnetic Needle.

[†] Appendix, p. 551.

4th, That the nearest end of the needle is drawn towards the point from whence the motion of the aurora proceeds, and that its deflections are greatest when the motion is most rapid,—the effect being the same whether the motion flows along a low arch or one that crosses the zenith.

5th, That a low state of temperature seems favourable for the production of brilliant and active corruscations, it being seldom that we witnessed any that were much agitated, or that the prismatic tints were very apparent when the temperature was above zero.

6th, That the corruscations were less frequently visible between the first quarter day, and the full moon, than in any other period of the lumination, and that they were most numerous between the third quarter and the new moon *.

7th, That the appearance of the aurora was registered at Bear Lake in 1825–26, 343 times, without any sound having been heard to attend its motions.

8th, The height of the aurora was not determined by actual observation, but its having been seen on several occasions to illuminate the under surface of some dense clouds, is conclusive that its elevation could not have been very great. When Dr Richardson and Mr Kendall made their excursion on Bear Lake, in the spring of 1826, the former saw the aurora very brilliant and active, displaying prismatic colours in a cloudless sky (on 23d April); while Mr Kendall, who was watching at the time, by agreement, for its appearance, did not see any corruscation, though he was only twenty miles distant from Dr Richardson.

9th, The gold-leaf electrometer, which was kept in the observatory, was never affected by the appearance of the aurora.

10th, On four occasions, the corruscations of the aurora were seen very distinctly before the day-light had disappeared, and we often perceived the clouds in the day-time disposed in streams and arches, such as the aurora assumes.

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* The proportion of corruscations seen at these periods, from the month of October 1825 to April 1826, was 38 to 125. The moonlight being strong between the first quarter and the full moon at those hours when we more particularly watched for the Aurora, may, perhaps, account for our not having seen its corruscations so often during this part of the lunation.

The opinions I have ventured to advance above, are at variance with the conclusions drawn by Captains Parry and Foster, from their observations at Port Bowen,—those officers inferring that the aurora does not influence the motion of the needle: but the discrepancy may be perhaps explained by the difference in activity and altitude of the aurora in the two places. I have stated that the needle is most affected when the aurora is very active, and displays the prismatic colours. Captains Parry and Foster have informed me, that the aurora seen at Port Bowen was generally at a low altitude, without much motion in its parts, and never exhibiting the vivid prismatic colours, or the rapid streams of light, which are so frequently recorded in our registers, of its appearance at Fort Enterprise and Fort Franklin. At both these places, we as often witnessed the corruscations crossing the zenith, as at any other altitude, and under such a variety of forms, and in such rapid motion, as to baffle description.

From the difference in the appearance and activity of the aurora at Port Bowen, and Forts Enterprise and Franklin, an inference may be deduced that the parallel of 65° N. is more favourable for observing this phenomenon, and its effect on the needle, than a higher northern latitude.

A Sketch of the Climate of the Mediterranean, with Remarks on its Medical Topography; being the result of Five Years' Observation. By the late WILLIAM BLACK, Esq. Surgeon, Royal Navy; and communicated by Dr BLACK of Bolton in Lancashire.

THE great basin of the Mediterranean, from its lying between countries differing so remarkably in their several localities and productions, has its general climate impressed with a mixed character, which it is as interesting to study, as it is important to analyse. Though the average climate for twelve months may be called equable, which is the character it has in England, yet there is, perhaps, no similar extent of water and coast where great climatorial vicissitudes are so plentifully produced by differences of situation and changes of wind. The Father of Meteorology, as well as of Physic, in his treatise on Airs, Waters, and Localities, has faithfully recorded the influence of winds and situation on the constitution of the atmosphere; and, from every observation which I have been enabled to make, it appears, that, amidst the wrecks and changes which the face of every country on the shores of this sea has experienced, the same characteristic climate, general and particular, exists, as it did, upwards of twenty-two centuries ago; and that the observations of Hippocrates may still be considered the best synopsis of the meteorology of this part of the world.

Equable as the general climate has been remarked to be, yet, if one day is compared often with another, or one part even with another of the same day, the atmospheric vicissitude is sometimes very considerable; and particularly as respects the humidity of the air. Such changes are most sensibly felt on the shores of Europe, and on the south coasts of Greece and Turkey in Asia; and it is on a line, equally distant from Africa and Europe, that such variable states of the atmosphere are least perceptible. Malta is, therefore, thought to be most out of the sphere of this vicissitude, yet a great change of wind at this place is attended with very sensible changes of its climate; and it is by no means that desirable residence for an invalid which it is thought by many to be.

A moist or damp atmosphere is certainly to be avoided by the majority of invalids; and that of England is so much blamed in this respect, as to be accounted the chief cause of the pulmonary complaints prevalent in the kingdom. The moisture of the English atmosphere, except under the influence of rare localities, is perhaps less than that of Malta; for Humboldt has found, by hydrometrical observations, the superior humidity of the atmosphere as we approach the equator. Invalids who generally resort to Malta and Italy, are of relaxed fibres of body; and one argument against the salubrity of the last mentioned place for them, is, that, in removing from England, they avoid little, if any, atmospheric humidity; added to which, they remove to an increased temperature, which must still farther increase the relaxing effects derived from humidity. In corroboration of this, we every day see people who, by chronic disease, have been reduced to an enfeebled and very relaxed state of body, sent from the Mediterranean to England with the happiest effect; while it is an established rule in the fleet, to remove every one immediately from the climate who betrays any incipient symptoms of phthisis. I have also seen cases of chronic and syphilitic rheumatism deriving, particularly, the greatest benefit from a return to England. But, to resume the natural history of the subject,—Though the extensive surface of this midland sea, lying between the 31st and 45th degrees of north latitude, and embracing about 40° of longitude, has a general climate, constituted by the regular succession of seasons, like all other geographical surfaces which have a marked summer and winter; yet the several places bordering on and within its ample circuit, have climates peculiar to themselves. These peculiarities are compounded of the general Mediterranean climate at any given season of the year, and of the collateral influence of the winds prevailing at the time, conjoined with the nature of the land which surrounds the place, and over which these winds previously blow; whether the sea, and what extent of it, lies in the course of the winds; and whether it is situated on the north or south shore of the mainland or island. Before, however, noticing the few remarks which I have personally made on the particular topography of the climate, I shall first give a summary view of the great modifying, if not elementary, principles of *Heat* or *Temperature*, *Humidity*, the *Winds*, and *Electricity*, as observed in the Mediterranean, for the space of more than five years.

Temperature.—It will be seen, from the table annexed, that the average temperature of the year at noon is considerably above what is called temperate in England, being for three years very near 67°; and from the thermometer being registered always on board in an airy and shaded situation, it may correctly be inferred that the temperature on land is a few degrees higher. Equable and mild as this annual heat is, yet the changes from day to day, or from morning to night, are sometimes as great as they occur in England, during the same space of time. The average heat for the summer of three years never exceeded 81°, nor was it below 74°; and, in the winter months, it never descended below 54.6,° which is 2° above the mean annual temperature at Gosport, as observed by Dr Burney *. This extreme monthly temperature of 54.6° in February 1824, was attributed to the strong northerly winds which for ten days prevailed at Smyrna; and as the average for the same season in the other two years was nearly two degrees higher, I should consider that they best expressed the corresponding temperature in the two years in which my daily register was not kept. The highest range observed at noon was 86°, which was off Algiers, in August 1824, and the lowest was 41°, at Smyrna, in the evening at eight, in January 1827. The range of the summer months never exceeded 11°, while that of the other months was often as much as 25°. For three months after the summer solstice, the heat on board was steady above 76°; and when the winds at this season are scanty, the thermometer is sometimes above 90° on shore. If it were not that the great heats of summer exhaust the sources of humidity, the atmosphere would be felt the moistest during the greatest heat. We should, also, have the heaviest dews at night; but the reverberation from the heated surface of the earth often keeps the vapour suspended through the night, though clouds may be precipitated in the higher and cooler regions.

Besides the characteristic temperature of the season, the heat at any place is moreover greatly affected by the winds at the time; thus, the westerly winds will not disturb much the regular increase or fall for the season, and the easterly but little; while the winds from the north, before the melting of the snows on the Appenines and on the Chain of Pindus, in May and June, will lower the temperature many degrees on the south coasts of Italy and the Morea. The south and south-east winds will, on the other hand, as remarkably elevate the thermometer; especially if they have blown steadily for a few days, and not over a widely intervening extent of sea. The effect of warm winds, immediately succeeding those from the north or a cold quarter, has often been observed to be productive of severe ca-

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* From registering thermometers kept for several years at London, it appears as calculated in the British Almanac for 1828, that the mean temperature of the year, by night and day, is 49°4. The mean *daily* temperature of the year in the south of Scotland has been verified to be about 54°, and that of Devonshire to be a degree or two higher.—J. B.

tarrhs; and to elicit those affections, it seems necessary that the warm and moist winds should be preceded by cold ones;—having some analogy to the circumstance of individuals catching cold, or a catarrh, not from being exposed to cold alone, but from coming into a warm room immediately after exposure to the cold air.

Humidity.—The hygrometrical condition of the atmosphere is an important object of attention in any climate, and it exerts a great modifying influence in that of the Mediterranean. This state of the air is very much affected by the direction of the winds, as well as by the temperature at the time; it also nearly observes variations corresponding with the temperature, being generally, in its sensible qualities, drier as the air is warmer, and moister as it is cooler. An exception to this concomitancy, however, exists in the currents of air over an extent of sea being always moist, whether in summer or winter; though, it must also be added, that the Sirocco, if felt moist at first on the northern shores of the Mediterranean, becomes drier if it continues for some days; and it sometimes will arrive there in all that arid state which is experienced on the coasts of Barbary and Egypt. Winds off land free from marshes, are dry in summer; and they are steadily moist, if they blow from snowy surfaces in the advanced part of the cold season. They are therefore moist, from moist places, in winter, under many changes of the wind; for the temperature never descends so low as to reduce the evaporation to a nullity, but ranges between those degrees on the scale where the dew point is very near the point of saturation.

At Modon, in the south of the Morea, the humidity in summer is much influenced by the prevailing winds. After the snow has melted on Pindus, Olympus, and Mount Taygetus, the land winds are dry, and the south winds are moist. If these last have blown for a length of time, they become drier, especially if they are of the Sirocco, and even if they have blown over the sea long in any direction; for it appears the longer winds blow over the sea, if it does not get agitated, the evaporation becomes less, and it is much greater after rains or heavy dews, which seem to form a thin stratum of fresh water on the surface, liable to be instantly evaporated on the first increase of hygrometrical capacity. At Patrasso and Lapanto, the variations in the atmospherical humidity are very trifling, from the winds, in most directions, sweeping over the land, which influences the proximate effect of their previous condition. Many other examples might illustrate the effect that surfaces, over which the winds blow, have on the humidity of the atmosphere. Thus I have found, in coasting round the Morea in summer, when the wind was from a great extent of sea, that the air was always damp. Off Navarino, it was extremely so, when it blew from any other point but over the Morea. In the course of a voyage, the same winds will be felt changing their hygrometrical condition with the different localities over which they travel. Off Navarino, a north-west wind will be moist, while, under the lee of Zante, it will be found dry. In running from Cape Angelo to the d'Oro Passage, a northerly wind has been found dry, with all the arid and bare Cyclades to windward; while, after getting through the Passage, the same wind has become excessively damp, and continued so until the Gulf of Smyrna has been made, when it again became dry,—it blowing over Mitylene, after having previously traversed an unknown extent of terra firma.

Temperature depends not so much on surrounding localities, as on the season; while humidity is more affected by the surface over which the wind blows than by the season. Even in the latter part of summer, when the land becomes a great reverberator of heat, arising, in a considerable degree, from the decay of its verdant vegetation, the temperature of the air suffers no great change from a change of wind; yet its aqueous condition will be much affected. In calculating, then, on the dryness or moisture of the air, the point of the compass from which the wind blows is not so much to be considered, as the surface, land or sea, over which it travels, and the extent of that surface, with the intervening locality, if any exist. At Malta, I have observed the hygrometer stand the highest, with the wind from the north; and the lowest, with a wind varying from S. to E. in the months of July and August. From the Meteorological Table, it will be observed that the proportion of fair weather is much greater than it is in Britain; and that the rainy and showery days (which were registered *rainy*, when rain fell even for a few hours, and *showery*, if one shower happened during the 24), do not amount to six weeks on an annual average for three years. It must be added, however, that the rains, when they do occur, are generally very heavy; and that the dews, in fine unclouded weather, are copious *.

Winds.—From the observations of five years, I have found the prevailing winds to be from the northward; and particularly when the weather assumes a steady constitution, and the summer season has fairly set in. In the winter, the winds do not appear to blow particularly from any quarter of the compass, but veer very much between the NE. and S. In the fair weather of summer, variable and light winds mostly prevail, and in winter they are less frequent. After the hilly country in Greece is covered with snow, if the winds blow from any direction more than another, it is from the S. and SE.; but, when the snow is dissolving in the spring, the vicissitudes of both wind and temperature are very great. The Sirocco, at this last period, though it seldom blows long at a time, is not so warm as it is in the beginning of winter, and differs very little from a moderate breeze from any other point, in consequence of its not blowing long enough to bring on its wings the milder temperature of the south; and therefore it is moist, cold, and relaxing.

The greatest number of cases of fever which I have witnessed on board ship on this station, followed the prevalence of S.SE. or light variable winds in May and June, at Corfu; while, in October of the same year, when diarrhoea prevailed, the winds were northerly. At Napoli di Romania, I found cynanche and other affections of the mucous membranes particularly prevail, after keen northerly winds, with a clear sky, had been preceded by occasional light Sirocco winds.

To shew how localities will at times affect the temperature of the winds, in opposition to the regular effects of the season, I have found the north wind off the coast of Calabria to be hot and dry in the latter end of September; while the wind, the next day, from the S.SE. or SW. was excessively damp, and accompanied with a cloudy sky. This anomaly arose from the small quantity of rain that had yet fallen in Italy, not being sufficient to cool the surface of the land; while, on the other hand, this hot and dry wind had acquired much humidity from the sea, before it retrograded and was repelled by the succeeding southerly currents. The Sirocco or SE. wind is an important one in any part of the Mediterranean; and different opinions have been formed as to its dryness and moisture. The fact is, that these qualities are entirely governed by the surfaces over which it blows, before reaching the place of observation. Thus it is moist and warm, as felt on the coasts of Greece and Italy; because its exalted temperature imbibes much vapour from the sea, after it leaves the northern shores of Africa, where it is hot and dry. Nowhere can such a wind be felt in the interior or the northward of Europe; for there is nowhere in Europe such a country as the Lybian and Arabian deserts, so flat, so dry, and so little capable of imparting to its winds any thing like the electric condition of the land and atmosphere of other countries[*].

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* The average of rainy, snowy, and showery days in Britain, during the year, compose about one-third of the 365, as may be seen by referring to various registers reported from time to time in the *Annals of Philosophy.*

Electricity.—This is a modifying element in the constitution of every climate; and, though less appreciated than heat or humidity, it no doubt performs a most important part in all atmospheric changes; if it is not an essential agent in every modification of cloud, dew, and vapour. The influences of heat and humidity are much more easily defined than those of electricity; which, though in constant operation, only enables us to draw any satisfactory induction from its great and palpable phenomena. Evaporation was long thought to be a fertile source of electricity; and Pouillet[†] has lately proved this opinion to be well founded, as well as that chemical and vegetable change is accompanied by electrical disturbance.

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[*] To shew the different directions of the winds at London, from those of the Mediterranean, as registered in the Table, the average winds for the year, at the metropolis, are here extracted from the *British Almanac* for 1828. The difference between the northerly winds is very remarkable.

N. 30¼ days.	E. 25½	S. 28¾	W. 70¼
NE. 44¼	SE. 38	SW. 72¾	NW. 54¾

[†] M. Pouillet, in his Memoirs read before the Academy of Sciences, on 30th May and 4th July 1825, has shewn that the absorption of carbonic acid by vegetables, and the evaporation of all liquids, pure or impure, are accompanied with the developement of electricity.

Of the grand phenomena of this subtle yet mighty agent, the Mediterranean exhibits every year many conspicuous examples; and especially when the summer constitution of the weather breaks up for the season. During the winter and spring months, thunder and lightning do not often occur; but I have never observed the season to change during the decrement of temperature, without more or less of electrical phenomena taking place, and often to a frequent and great extent. In the months of August and September, when the temperature thus begins to fall, and the winds have blown from the north, and over any extent of sea, for some days, the atmosphere will become often obscured with irregularly formed clouds to leeward,—the wind will next change or abate, and, during the evening and night, successive evolutions of electricity will be seen on the upper part of the newly deposited clouds, which are precipitated, one after another, from the muddy and misty atmosphere above. Rain next succeeds without thunder; and in twenty-four hours the wind will again change steadily to the northward, with a clear sky, fine weather, and a permanent fall of the thermometer. If these phenomena are witnessed on the coasts of Italy and Greece, the deposition of clouds takes place over the high lands; and the electrical transitions are accompanied with thunder and forked lightning,—often exhibiting the sublimest instances of elemental commotion.

I always remarked the developement of electric light to be from the upper outline of the newly precipitated strata of clouds; and where these fresh charges of electric light were successively transmitted from cloud to vapour, they, no doubt, were accompanied with much evolution of caloric, from the vapour parting with its latent or constituent heat. The direct preliminary condition of such phenomena seemed to be a wind from the sea, or from the south. Such winds as the Sirocco are always attended with imperfectly formed clouds, or a hazy atmosphere; and, on the converse, I have often seen a change of wind to the south and east from the northward, completely dissolve the regular clouds, and render the air muddy and hazy. These remarkable electric phenomena will more particularly happen, if these south-east or south winds have blown for some time, and have been immediately preceded by northerly winds, or winds off the land. The reason of such phenomena not occurring at once, on a change of wind to the southward, arises, it seems, from the first of the southerly wind being only that body of the air which had lately blown from the opposite or northerly quarter, and which must precede the true current of the south, with its characteristic properties. It is for this reason, that we often found a cold southerly or south-east wind at sea, where no localities could have immediately influenced the temperature, such as at Malta and off Cape Spartinento. From this cause, also, the longer a Sirocco blows, the drier it becomes; and, in the vicinity of such elevated land as the Albanian ridge of mountains, this partial change to warmth with moisture, in the Sirocco or south wind, may be considered indicative, in the fall of the year, of a thunder storm, or the lesser electrical phenomena, with a fall of rain, and a change of wind.

It is evident, also, that besides the humidity and heat, which form a great difference between winds proceeding from the opposite points of north and south, there is something else connected with the air and the surfaces over which its currents pass, that affects the animal system in that remarkable manner which is witnessed during a Sirocco or southerly wind. On a change taking place to this direction, the inhabitants of a place, and those who have lived but a short time in it, sensibly experience a languor and relaxation of both the mental and physical energies; while diseases, depending on laxity of fibre or emunctory, become at the same time aggravated. Thus dyspeptic complaints, chronic catarrh, and cynanche, make no progress towards recovery; and if the Sirocco blows immediately after a cool northerly breeze, it often proves the cause of developing such diseases.

What this depressing something is, it may at present be premature to dogmatize about. There is an era, however, to which medical science is fast hastening, when this will no doubt be explained; since the progress, which all the auxiliary sciences are making, point out to us that such a consummation will happen. To elucidate somewhat this intricate portion of our subject, we shall make the best use of the data we possess, and the observations we have made.

As far back as 1770, it was conjectured by Brydon the tourist, that what has since been called the nervous energy, must be analogous to the electric fluid; and that the nerves served for the transmission of both. He illustrated his theory by the effects produced on the animal system by the Sirocco, or winds either partially or wholly deficient of their natural electricity. By the researches of Abernethy, Phillips, Bichat and Le Gallois, this conjecture of Brydon's has been much supported, so far as the analogy between the nervous energy and the galvanic fluid is concerned. It is well ascertained, that in damp or hazy weather none of the electric fluid can be collected; and, as the air of the Sirocco can receive no electrical impregnation, by sweeping over a dry and flat desert of sand; so the moisture, which it acquires in its passage subsequently over the sea, must give it a strong absorbing and conducting power for electricity. The consequence is, that this moist wind, coming in contact with bodies possessed of more electricity, will rob them of part of their electric fluid, until an equilibrium is effected between the earth and the air,—the grand final cause of all electrical phenomena. Now, as the human body readily parts with and receives electricity, and as an object, on the surface of the earth, must be a ready point for the transmission of the fluid, it cannot be supposed that it is physically exempt from those electrical influences which such winds produce on the rest of matter, but must lose a portion of the constituent fluid it previously possessed,—which loss is followed by all those symptoms of depressed energy already noticed.

The animal body, then, may be deprived by the atmosphere, in a series of degrees, of that energy which, if it is not the produce of the living functions, is at least the natural portion of electricity which the body possesses in common with surrounding objects at the time. Life may even be extinguished from the highest operation of this cause, as often happens during thunder storms, when no marks of physical injury can be detected.

The different electric states of the different winds are pretty well ascertained by stationary electrometers; and, though I had none regularly in my possession, I found natural phenomena themselves to afford both excellent and beautiful proofs of this quality in the several winds. The summer of 1825 presented very satisfactory examples of the important part which the electric fluid performs in meteorological phenomena, especially when the constitution of the cloudless sky of summer began to be deranged. As this change happened on the coasts of Albania and the Morea, it commenced by the north-east winds getting stronger, and veering more about from one point to another, with corresponding variations of temperature. A calm, alternated with faint southerly breezes, succeeded, which was followed by a thick atmosphere at sunset, lightning over the Morea, and rain after which it cleared up, and a north-west wind steadily prevailed. A few days afterwards off the Bay of Prevesa, the northerly wind fell, the atmosphere thickened, and the wind again sprang up from the south-east, light at first, and freshed through the night. About the following sunrise, inside the Corfu Channel, one of the most terrific thunder storms commenced that can well be imagined; which, after floods of rain, lasting, with slight intermissions, for several hours, terminated by a sudden change of wind to the northward, and soon afterwards a clear, cool atmosphere succeeded, with the wind from the north-west for some days.

Though more or less varied, the summer seasons, as I have before remarked, always break up in the above manner, and subside into a cool temperature. Whatever occasions the change of wind, whether it be from the land becoming a greater reverberator of the solar heat, arising from the decay of its verdure and foliage, and so rarefying greatly the superincumbent stratum of air, by which the cooler currents from the sea are elicited, it is very evident that the phenomena, described as attending such changes of weather, result proximately from the collision of clouds or strata of vapour differently electrified as to each other, or from the electric condition of the clouds being in a *minus* or *plus* state, as respects the subjacent land and mountains. For the better understanding of what takes place during these electric collisions, it is necessary to ascertain what respective body of clouds is *plus* or *minus* electrified; or whether it is the high land, or the atmospheric stratum impinged against it by the Sirocco, which gives or receives electricity during the restoration of that equilibrium which ensues. The experiments which have shewn the negative electric state of the Sirocco, are highly corroborated by the following considerations. In the *first* place, as the earth is the centre and source of electricity, as well as of gravitation, and over which the former fluid must be distributed nearly in an equal manner, it is not probable that any of the prominent parts of the earth can ever be long in a *minus* state, compared with the incumbent atmosphere, when not in much motion; although the land remaining in its natural electric state may present, in certain places, points of attraction for the discharge of any clouds or vapour passing over it, and being in a positive state of impregnation. The winds from the sea and the southward seem, however, not to contain sufficient electricity to balance that of the land, which they meet with on the northern shores of the Mediterranean, or that of the winds, which blow from any extent of hilly land to the northward; for they travel over a surface of water, through which they can receive little electric impregnation; while they become charged with much humidity, which renders them very susceptible of receiving electricity, wherever it is presented in a comparatively positive condition. In tracing these winds to the S. and SE., they are found traversing boundless plains, hot, sandy, and arid, whence no electric fluid can be extricated, nor can they be held to contain more than keeps their constituent gases together. Arriving in a dry and non-conducting state on the northern coasts of Africa, these southerly currents afterwards sweep over the intermediate sea, and soon, from their high temperature, become charged with humidity, which, from want of electric fluid, never gets embodied into regular clouds, but the atmosphere looks thick, hazy, and muddy; the sudden appearance of which during a northerly wind, is always a sure indication of a change to the southward in a short time. Having reached the coasts of Italy and Greeece, and coming in contact with the elevated mountains, these currunts of vapour assume the form of regular clouds; and, collecting, exhibit the transmission of electric fluid to the succeeding currents of humid air; which, often suddenly condensing into rain, rapidly increase the south-easterly influx towards the same points, and create such a mass of negative atmosphere, that all the grander phenomena of thunder, lightning, and torrents of rain, are developed.

Besides these illustrative instances of the relative electric states of the opposite winds above mentioned, analogous phenomena are sometimes observed at sea, and out of the immediate influence of the land. Thus, a wind, blowing from the northern shores of the Mediterranean, may be in perfect equilibrium with the land it leaves; yet, when it encounters the southerly current at sea, will be in a relatively positive state of electricity. The consequence of this collision will be, a transference of the fluid from the north to the south current; and, according to the extent of the electric difference between them, will be the amount of the resulting phenomena. From the observations of five years, I have always found, that, when electrical phenomena appeared, a change of wind from N. to S., or from opposite points near to the meridional line, invariably occurred. One difference has been noticed in the character of these phenomena; that, when they were developed in the vicinity of high land, thunder accompanied them; but, at sea, it seldom or never occurred; the transfer of the electric fluid, in this last situation, appearing to take place in a more gradual and less violent manner, than when the peaks of mountains facilitated these local accumulations, whose disturbance creates such intense results.

As a general observation on this part of the meteorology of the Mediterranean, it may be inferred, that winds or currents of vapour, of some continuance, from an extent of sea, are *negatively* charged with electricity; and those from the land, and especially from hilly countries, are relatively in a positive condition.

During the period in which I have been in the eastern section of the Mediterranean, abundant opportunities have occurred of witnessing the effects of localities on the temperature and humidity of the winds, even when they continued to blow from the same quarter of the horizon; as well as of observing how the climates of particular places are affected by the nature and direction of the winds, and the atmospherical impregnations prevailing at the time. These opportunities have resulted from being often one day to the northward, and the next to the southward, of land, with the continuance of the same wind; at another day, with a great scope of sea, and on the following one with an extent of land, in the direction of the same winds; while frequent visits to different places and anchorages, in different seasons of the year, have furnished me with some personal observations on their respective climates. I shall therefore conclude this sketch with a few climatorial notices of such places as may be more frequently visited by the traveller, and by ships of war and commerce, reserving to a future opportunity a more ample detail of this department of Mediterranean topography.

Zante.—Of all the anchorages in the Ionian seas, that of Zante Roads seems to be the most eligible in point of salubrity; as the moisture and relaxing qualities of the Sirocco are there greatly qualified by the wind first passing over the east end of the island. There is also no great extent of land or sea in immediate connection with the port; from which circumstance, the shifting of the wind from one point to another is not attended with very sensible changes of heat or moisture; and, unless the calms are prevalent at night in summer, which they seldom are, there is very little humidity or dew precipitated. The breezes from the N. and NE. are very frequent and refreshing, and generally set in early in the forenoon, as the sea-breeze, and subside at night during the warm season of the year. This anchorage is also free from any malaria.

Sta. Maura.—The next anchorage to that of the Roads of Zante, in point of healthiness in the hot season of the year, is the south anchorage of this island, the ancient Leucadia. Being bounded by the high land of the island on the west, and by that of the Acarnanian hills to the eastward, this anchorage has the winds dry from these opposite directions; while the currents of air in the direction of the channel, whether they are N. or S., are more moist. Even when the wind blows from the S. and SE., it is moderate; and, from the lands and islands, which lock in the anchorage, and are devoid of wood and sources of humidity, the place is never very damp, or pernicious by night. The winds, however, blow seldomer from these last directions than from the opposite points, whence they are cool, dry, and refreshing, in the hot months. In the direction of N. and NE., there is much low land, and even stagnant water; but such an extent of sea and dry land intervenes, that their influence is not much to be dreaded.

In the north anchorage, however, of this island, I should think the effluvia from the lake near the town would prove insalubrious, it being extensive, and also near to the port. This anchorage is seldom visited by any of our fleet.

Pouqueville relates, that, on the approach of those appearances in the air, and the fiery colour of the sun, which precede the earthquakes to which this island is subject, the female inhabitants are seized with a species of hysteric convulsions, called *miterico;* but I have no personal knowledge of such affections *.

Cephalonia.—Judging from the situation of the extensive harbour of this island, I am inclined to think it a rather healthy anchorage. The great height and extent of sun burnt surface on the one side, over which the wind comes as if from an oven, when it blows in that direction, the low and small extent of land across which the Sirocco has only to pass before it reaches the port, and the great scope of sea over which the southerly winds previously travel, constitute, however, some demerits worthy of consideration, and counterbalance the other presumable advantages. The stagnant head of the harbour, beyond the long bridge, must, besides, prove a source of miasmatic effluvia to the crews of those vessels of a smaller class that refit there and careen. I have seen the first onset of the Sirocco down the harbour raise the thermometer ten degrees. The south-east wind in passing over the island of *Zante*, is much increased in temperature and dryness during the summer season; and in the winter it is thereby rendered colder, if not more moist. These relaxing SE. winds very often produce severe catarrhs, especially if cold winds have previously prevailed.

Corfu.—This is an anchorage where a good deal of fever occurs in the hot months; and I have witnessed its prevalence for several years. In this season the winds are light, or calms prevail; and at night, the dews are generally very heavy. When the winds blow, it may easily be observed, from the nature of the surrounding localities, that they will imbibe febrific exhalations. To the NW., and in the line of the greatest extent of the island, there is a good deal of wood, many ponds of stagnant water, and some marshes, the exhalations from which, in hot weather, must give a malerious influence to the winds passing over their surfaces. The above is also the direction whence the land-breeze in the night reaches the anchorage; and I have often perceived the same fetid smell accompanying the first of the evening breeze, which I have experienced at Port Royal, Jamaica, at Messina, and off the Italian *fiumares*.

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* Pouqueville, Voyages en Grece, tom. iii. chap. 101.

As to the *modus operandi* of these land breezes, impregnated with marsh vapour, it is difficult to say whether they act by suddenly repressing the perspiration, from their being charged with humidity, and of a relatively low temperature, or by depressing or impairing the nervous energies in the same manner as the Sirocco does; or whether they may even operate in both ways on the animal system. It is, moreover, well known, that fever is more often developed in the night time, or in the evening, when the energies of the body are most exhausted from labour, fatigue, and the excitement of a hot day; while I have particularly remarked, that its invasion in this climate is always declared by symptoms of exhaustion and depression. These are syncope, sudden failure of muscular strength, and disturbance of the reparative functions, with the expulsion upwards or downwards, from the primæ viæ, of what the organs cannot digest or assimilate. The adynamic state of the moving powers is observed in the pallor of the surface, and the depressed state of the pulse. During the summers in which I have seen fevers prevalent at this anchorage, southerly and SE. winds occurred by day, and at night it was either calm with heavy dews, or else it was a land breeze possessed of the qualities above mentioned. The other localities of Corfu, if not so unfavourable, possess no entire exception from the unhealthy impregnations which they impart to winds arriving at the anchorage. From the eastward, there cannot be any cool sea breeze by day in the summer months; as the expanse of sea is only seven miles between the island and the bare and parched land of Albania, while the greatest surface of sea is down the channel, which lies in a SE. and southerly direction, whence the breezes are warm, moist, and relaxing.

The change of the season, however, changes the influence of locality on the winds of the place, as it does on those of other places. For six months in the year, the snow on the gigantic mountains of Albania is a fruitful source of cold and moisture to the winds sweeping over them; and, therefore, in the early part of summer (in April and May) a change of wind from the S.SE. or SW., to the direction of these mountains, is attended with a sudden and great decrement of temperature; while a contrary effect as remarkably obtains on a reverse of the prior phenomena. The chief complaints, resulting from such changes of wind, are catarrhal and mucous affections, which are quite endemical in such seasons. When the snow is melted, the breeze from the mountains would be not only warm, but dry; but as seven miles of water intervene, the breeze always gains a degree of humidity before it arrives at the anchorage. These easterly winds are, however, not frequent during the hot months; but if they gently prevail, in the evening a haze generally settles down on the tops and shoulders of these mountains, occasioned by the reverberation from their heated surfaces preventing the deposition of dew from the humid strata of the incumbent atmosphere.

Ithaca.—This is a good anchorage in the hot season; for though the island is sterile, it is dry, and possesses few or no sources of hurtful exhalations.

Acarnania.—The whole coast about Missolonghi, and the mouth of the ancient Achelous, is very unhealthy, especially during the autumnal months; as the marshy and low lands in this diluvial region are an extensive bed for the production of noxious exhalations; and I would recommend no vessels to anchor by night near this coast in that season of the year. In May 1826, a good deal of fever made its appearance on this coast, and which was declared to be of the typhoid variety. It was communicated to one of our vessels of war. Whether the disease was solely to be attributed to the marsh exhalations, or partly to the destitution and misery which were spread over the neighbourhood after the fall of Missolonghi, I have not been able to determine.

The high land of Albania moderates the sultry and oppressive quality of the Sirocco at Corfu; though, while it blows, the atmosphere by day is hazy, streaked, and disturbed; and by night, it is often clear from the deposition of dew, if calm, or the air is beset with light and regular clouds, which are again converted into haze, by the next day's sun. It is late in the spring before the high land in northern Greece gets sufficiently heated to make the land breeze feel warm, or even temperate; and I have seen from Corfu, in the beginning of June, the whole range of Pindus deeply coated with snow. As summer advances, the winds get light and variable, and are accompanied by a warm and sultry sky in the day time, followed by heavy dews at night.

In the *Gulf of Kolokythia*, anciently Laconia, during the summer, the breeze sets up the gulf in the morning, and dies away towards night; and I have never verified the effects of any malarious winds at night, even when they regularly set in from the land, in the months of August and September. One of our sloops of war, however, experienced a good deal of fever in this gulf in the autumn of 1825.

The inhabitants of the neighbouring parts of Laconia are much subject to boils and ulcers at this season of the year, and they generally looked unhealthy.

Cerigo is a high lying island, and is well exposed to the winds in all directions. I found fevers, however, here very prevalent in August 1825; but the disease was principally among the Greek soldiers. The inhabitants, in the absence of all malarious ground, attribute their attacks of fever to changes of wind, from the north to the southward. In Port St Nicolo the temperature was 85°, and the breeze followed the course of the sun in the middle of the above month; though at sea the winds were more fixed to one point. Remittents and agues continued to prevail here in the latter part of the above year, even towards the interior of the island. This sickness was more remarkable, as there is no observable source of miasma, the surface being dry, and free from wood, and the above changes of wind from one point opposite to another, being the only concomitant meteorologic phenomenon. The season broke up rather early this year by thunder storms.

I have observed, on arriving in the Gulf of *Napoli di Romania*, in the winter and spring seasons, from Malta, a great depression of temperature, with a continuance of the same northerly winds, owing in some measure to the anchorage being completely surrounded with snowy mountains. The winds passing over these in the day-time, become saturated with humidity, and the air being at that temperature in which the range from the point of saturation to the dew point is very limited, viz. between 45° to 54°: this humidity is easily precipitated.

Though I have visited the site of the famous lake of Lerna, on the western side of the gulf, I cannot say whether the Hydra snake, whose numerous heads Hercules repeatedly cut off, yet exists under the less palpable form of the no less venomous miasma; but I should think, from local appearances, that even Hercules himself might yet find enough to combat with the demon of the place.

At *Milo* there are many sources of febrific miasmata; but when the winds blow from the northward, they only traverse the promontory of the high and dry land, which forms the east shore of the harbour. To the south of the anchorage, however, there is a good deal of low and marshy land, over which a fog, morning and evening, in calm weather, generally rests; and from which the occasional breezes must arrive, charged with much exhalation. In the same southerly directions there are some hot sulphureous springs, which, whatever their influence may really be, are carefully avoided, as hot-beds of sickness, by the inhabitants. It is well known that sickness has raged at times severely in this island; and the ancients seemed to have been aware of the insalubrity of the part mentioned, for all the ruins of antiquity are found to the northward, or on the more elevated land. In the autumn of 1824, a fever broke out, and carried off a great many of the inhabitants. It was said to have been brought from Candia by some Greek refugees, who principally fell a sacrifice to it. I was told by a Miliote, for they have no medical man on the island, that those whose sickness was followed by an ague generally recovered.

In May 1826, I found a good deal of fever among the Greek troops at Athens; but there were sufficient causes productive of such distempers among them, without the aid of any malarious breezes from the marshy Cephissus, or the swamps in the course of the Ilyssus, towards the Pireus.

At *Smyrna* the winters are generally temperate, and the lowest point of the thermometer observed by me, during the season of 1826–7, by night as well as by day, in the open air, on board, was not below 41°; between which and the highest 72°; there were, however, many vicissitudes, both as to humidity and temperature. The changes of weather are not so suddenly marked here as among the Ionian islands, or on the coasts of Greece. The influence of locality is also remarkable; the south-east wind having not much of the character of the Sirocco, and the atmosphere, at the time, not being hazy, nor accompanied by those sensations, which are felt during a Sirocco on the coasts of Italy and Greece. As a general observation on the winter season of the year, there is less variation in the temperature and hygrometry of the air than to the westward. The wet points are south-west and west, and the difference of temperature between south-east and north is, at times considerable. At the greatest depression of temperature, catarrhal complaints prevailed much on shore, as well as on board, and were attended, in many cases, with much fever. The winds were then north-east and east, in which direction the land in the distance was covered with snow.

In the month of October 1824, while visiting the coasts of Asia Minor, and being off the Troades, some intermittents made their appearance among the crew of the Euryalus, and I was led to attribute them to local influences. The plains of old Ilium are low and extensive, and at a short distance from the beach is the marshy course of the Scamander; and in the vicinity of the ruins, and more to the interior, is the wider and paludal course of the Simois; both of which are very probable sources of febrific exhalations. The average temperature in the above month on this part of the coast was 69° on the main deck, and the weather was in general pleasant.

The south and south-east shores of *Sicily* are liable to great vicissitudes; and the Sirocco there is much complained of by all travellers.

It is needless to speak of the beautiful and breezy Bay of Naples, the refreshing salubrity of which is proverbial; but remarkable vicissitudes of climate nevertheless occur on changes of wind from off the sea to the land; which are again materially modified by the winds sweeping over the Appenines, when covered with snow, or reverberating the heat of an autumnal sun.

* * * *

Malta is perhaps as free as any situation in the Mediterranean from terrestrial sources of unhealthiness; and Valetta enjoys a happy immunity from the injurious effects resulting from changes of wind, being situated to the north side, and having its Sirocco winds ameliorated by their first traversing the surface of the island. In winter the northerly winds are always rendered more temperate, by their previous passage over the intervening sea, after they leave the cold surface of Europe; while along the southward of Greece, those winds are then felt in all their original frigidity. The opposite results obtain in the latter part of summer; the northerly winds are cool at Malta, and hot and dry on the south shores of Greece. I have seen, in March, a fall of hail stones on the island, about an inch in depth; and at this time of the year, the winds often, from their great and frequent changes, lose their distinctive characters; thus, the south-east, or Sirocco, has been found cloudy, cold and wet; and the westerly and south-westerly winds neither mild nor warm; all these anomalies arising from the frequent changes, tossing backwards and forwards the same mass of atmosphere and clouds.

Algiers.—Though the plague rages sometimes at this place, yet its natural situation keeps it free from any endemic causes of sickness; and it may be reckoned a healthy place, owing to the high land to the southward tempering the heat and dryness of the winds of the desert. All winds here from east, through north to west, are damp or foggy in the summer season.

In August 1824, an interesting coincidence, between the appearance of nineteen cases of febrile commotion and a sudden change of wind, took place off Bona, in the Euryalus frigate.

The previous winds for some days had been moist, and from the northward, when they were interrupted for two hours by a strong Sirocco, accompanied by a great rise of temperature; and so arid was the wind, that any thing moist or damp dried in it as quickly as if it had been exposed to the fire. "The marked attacks of fever were simultaneous almost with the Sirocco, and they disappeared in a short time, from the use of gentle depletion, and with the quickly succeeding change of weather."

Towards the east point of the northern coast of Africa, the sand from the desert often reaches the Mediterranean, and gives a light yellowish hazy tint to the atmosphere. At Alexandria, with the breeze at SW. by S., warm and dry, I have seen the finely pulverulent sands create a complete haze, and partially obscure the sun. I first supposed the haze arose from the humidity evaporated from the small extent of sea, and the course of the Nile; but finding portions of yellow sand collected on several exposed places of the ship, I was soon convinced of the true nature of the phenomenon. A change of wind, at Alexandria, in February 1825, from the NE. to SW. by S., produced an increase of the temperature from 56° to 76°, being 20 degrees in one day.

* * *

Conclusion by Dr B——.

To give a complete history and estimate of the climate of the Mediterranean, as connected with health and the developement of disease, it would be necessary to refer to an extensive set of good registers, and to bring forward an outline of the diseases which affect the various nations inhabiting its shores, as well as those which seafaring people and strangers experience. But as this was an extent of inquiry beyond the opportunities of the late author, the preceding sketch professes only to detail the simple meteorological phenomena which came under his observation; and the few inductions which he has drawn, may serve to illustrate the more obvious connections between health and climate. In giving the sketch to the public, the editor has thought to contribute some facts to meteorological science, as well as to fulfil the supposed wishes of one, of whom affection might truly say,

> "Nec carus æque, nec superstes
> "Integer."

A METEOROLOGICAL TABLE *for the Mediterranean, from August* 1823 *to July* 1825, *and from August* 1826 *to July* 1827, *all inclusive.*

MONTHS.	Average Temperature at Noon on Board.	WINDS.									WEATHER.				Electrical Disturbance.	PRINCIPAL PLACES OF OBSERVATION.
		N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm and Variable.	Fair and Clear.	Fair and Cloudy.	Showery.	Rain.		
1823.																
August,	80	23	1	...	...	1	...	2	...	4	28	3	...	...	1	South of the Morea, Ionian Isles.
September,	75.75	9	1	...	...	5	...	6	...	9	13	15	...	2	7	Tostizza, Ionian Isles to Malta.
October,	69.55	12	...	1	...	1	1	6	4	6	18	6	4	3	1	Malta, Naples, Genoa.
November,	58.17	12	...	6	1	...	...	2	1	8	17	5	6	2	...	Naples, Sea, Malta.
December,	58.	6	2	...	...	...	3	18	7	...	20	6	3	2	...	Malta, and at Sea.
1824.																
January,	57.55	6	1	4	...	1	...	10	1	8	16	9	2	4	1	Tunis, Malta, Archipelago.
February,	54.6	10	...	1	...	10	...	4	...	4	13	10	....	6	...	Gulf of Argos, Sea, Smyrna.
March,	59.16	9	...	...	4	8	3	...	...	7	15	10	2	4	...	Tourla, Tenedos, Rhodes.
April,	64.66	5	1	...	4	1	1	8	5	5	21	6	2	1	...	Pireus, Smyrna, Archipelago.
May,	69.74	14	...	...	1	5	...	4	...	7	24	7	...	...	...	At Sea, Malta.
June,	70.37	13	...	...	...	1	3	8	...	5	18	7	4	1	...	Malta, Naples, Leghorn.
July,	74.65	6	2	12	2	...	...	4	...	5	28	3	...	...	...	Sea, Algiers.
August,	79.16	6	...	2	1	...	...	8	...	14	31	...	...	...	...	Sea, Smyrna, Tourla.
September,	74.73	19	...	1	...	...	...	1	1	8	25	3	...	2	...	Bodrun, Paros, Pireus.
October,	69.04	9	4	...	...	8	2	2	...	6	10	10	1	1	1	Cyclades, Smyrna.
November,	64.27	8	1	...	1	2	1	3	1	13	18	10	1	1	1	Milo, Zante, Corfu.
December,	60	11	2	3	...	7	1	...	1	6	16	10	3	2	...	At Sea, Messina, Naples.

TABLE—Continued.

Months.	Average Temperature at Noon on Board.	Winds.									Weather.				Electrical Disturbance.	Principal Places of Observation.
		N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm and Variable.	Fair and Clear.	Fair and Cloudy.	Showery.	Rain.		
1825.																
January,	56.70	17	9	1	...	...	...	3	1	...	21	9	...	1	...	Leghorn, Sea, Malta.
February,	58.86	13	9	...	1	...	2	2	1	...	16	2	7	3	1	Malta, Sea, Alexandria.
March,	66.66	12	4	...	4	1	3	2	2	3	17	6	4	4	...	Alexandria, Sea, Malta.
April,	64.26	8	5	2	2	3	...	4	2	4	23	6	1	...	...	Malta, Sea, Corfu.
May,	71.13	6	1	4	...	3	1	3	7	6	19	12	...	...	2	Sea, Zante, Morea.
June,	71.87	4	1	...	2	12	...	1	2	8	16	10	3	1	...	Zante, Corfu, Dalmatia.
July,	77.23	9	...	2	...	5	...	...	2	13	23	4	4	...	2	Sea, Corfu, Sante Maura.
1826.																
August,	81.	20	...	...	...	...	...	...	2	9	30	...	1	...	1	Sea, Zante.
September,	75.36	7	...	2	...	...	1	2	2	16	24	5	1	...	5	Corfu, Archipelago, Malta.
October,	70.54	8	...	...	1	1	...	7	4	10	5	17	3	6	6	Malta.
November,	64.5	7	1	5	2	6	2	1	3	3	8	12	6	4	1	Malta, Archipelago, Smyrna.
December,	56.16	1	4	9	2	5	...	3	...	7	10	14	2	5	2	Smyrna.
1827.																
January,	57.45	4	3	1	2	8	9	2	...	2	14	12	3	2	1	Smyrna, Archipelago.
February,	59.35	5	3	1	4	1	2	5	5	2	18	7	3	...	...	Malta.
March,	62.	3	1	2	...	1	...	2	14	8	21	10	...	...	...	Malta, Messina, Naples.
April,	62.71	5	1	1	6	1	2	3	4	7	22	6	2	...	...	Sea, Marseilles, Malta.
May,	69.13	4	2	2	3	4	...	6	1	9	18	11	2	...	...	Sea, Cerigo, Zante, Corfu.
June,	74.	3	...	...	5	...	4	7	4	7	19	10	...	1	1	Ionian Isles, Archipelago.
July,	78.	4	...	8	...	...	...	14	2	3	26	5	...	...	...	Malta, Sea, Algiers.
Average 1st year,	66.02	125	8	24	12	33	11	67	18	68	231	87	23	25	10	
Av. 2d year,	67.32	122	36	15	11	41	10	29	20	81	244	82	24	15	7	
Av. 3d year,	65.61	71	15	31	25	27	20	52	41	83	215	109	23	18	17	
Av. for 3 years.	66.95	106	19.6	23.3	16	33.6	13.6	49.3	26.3	77.3	230	92.6	23.3	19.3	11.3	

Observations on the Arborizations in Dendritic Calcedony, or Mocha Stone. By AD. BRONGNIART [*].

FOR a long time, those irregular filaments observed in the varieties of agate commonly called Moss Agates, were believed to be confervæ. Daubenton was the first who made known his opinion on this subject [†]; and while he admitted the arborizations of agates to be mere infiltrations, he thought he distinguished in certain moss agates real vegetables, and in particular confervæ and mosses. The figures which he has published of these objects are too imperfect to enable us to form any idea respecting the forms which he intended to represent, nor have I been able to find any thing resembling them among the specimens preserved either in the old collection of the Jardin des

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[*] The following observation on mocha stone occur in my System of Mineralogy.

"The dendritic calcedonies, or mocha-stones, are much prized as ornamental stones. The arborizations, as already mentioned, are black, brown, or green. The black as the most common, and most distinct: the red, on the contrary, are rarer, and are less distinct, and are named *corallines*, from the resemblance of the dendritic delineations to coral; and the green are rare, and much esteemed. These arborizations appear in some cases to be owing to iron, in others to manganese, iron, and mineral oil. Deutens, Von Moll, Daubenton, and lately Lenz, Blumenbach, and Dr MacCulloch, maintain that many of them are of a true vegetable nature. Deutens says, that if the plants contained in calcedony are extracted, and the fragments thrown on burning charcoal, a bituminous smell is exhaled; and Von Moll maintains, that calcedony sometimes contains brown and green moss.

"Lenz affirms, that the calcedony found in the amygdaloid of Deuxponts contains musci of different kinds, such as Lichen rangiferinus, Confervæ, Byssi, and Brya.' And Blumenbach says, in a letter to Baron Von Moll, that though he had hitherto disbelieved the occurrence of vegetable bodies in the dendritic variety of calcedony named mocha-stone, he must now admit that it does sometimes contain plants, apparently of the nature of conferva. He observed these in specimens from Iceland and Catharinenburg. The same celebrated naturalist maintains, that he found, in the interior of an agate, the fructification of an unknown plant, somewhat resembling the *Sparganium erectum*. Dr MacCulloch, after examining several hundred specimens of mocha-stone, is of opinion that they contain cryptogamous plants. This opinion, however, still remains very improbable."—*Jameson's Mineralogy*, vol. ii.

[†] Memoires de l'Academie des Sciences 1782, p. 667.

Plantes, or in that of the Academie des Sciences. As to the confervoid filaments, a great number of specimens present them, which have the appearance of those figured by Daubenton; but we shall presently see what opinion is to be formed respecting those alleged converæ. After Daubenton, Blumenbach, in a letter to the Baron de Moll, of which an extract is inserted in the Annals of Philosophy *, admits, that, although he had until then rejected the presence of vegetables in calcedonies, he was persuaded that these stones sometimes contain actual vegetables, probably of the nature of conferveæ. He says he observed some in specimens from Iceland and Catharinenburg, and adds, that, in an agate which had belonged to a Japanese prince, he had recognised the fructification of an unknown plant, having a considerable resemblance to that of *Sparganium erectum.* This opinion, to which the name of so celebrated a naturalist might give authority, has unfortunately never been farther developed by its author, who has neither published a detailed description nor figures of the vegetables which he thought he had distinguished in these calcedonies.

The same opinion has been supported by Dr MacCulloch †, who alleges that calcedonies contain arborizations of two kinds, the one arising from the presence of vegetables, the other formed by mineral infiltrations. He asserts that these two kinds may be distinguished both by their external characters and by their chemical nature, the former always becoming black when boiled in sulphuric acid, while the others retain their original character, and produce a slight effervescence. The same naturalist says he sometimes observed articulations in these filaments; but unfortunately the figures which he has given of these objects are not sufficiently enlarged, and are consequently insufficient. If reference be made to these figures, it is certainly difficult to refuse admitting in some of them portions of vegetables even more complicated than converæ, such as Jungermanniæ. But these infiltrations sometimes emulate the external forms of a vegetable to such a degree, that one must be well acquainted with the plants of these families not to be deceived with respect to them.

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* Annals of Philosophy, 1814, vol. i. p. 217.

† Geological Transactions, 1st series, vol. ii. p. 510.

Anxious, therefore, to assure myself of the nature of these alleged vegetables, I examined a considerable number of moss agates, belonging either to public collections or to those of private individuals in Paris. I observed them not with a simple lens, but with Amici's excellent microscope; of which, however, I only employed the low magnifying powers of from 50 to about 100 diameters. In more cases, the transparency of these agates enabled me to see distinctly, at least in certain points, the disposition of the filaments, and I was enabled to assure myself, not only that they had none of the characters of plants of the family of Confervæ, or of any other plant, but that they even presented characters which proved them to be mere infiltrations, and not vegetables. I have represented, in figs. 7 and 8 of Plate I. of my work on Fossil Plants, the two forms under which these infiltrations most commonly presented themselves. Fig. 7 shews the disposition which the brown infiltrations of the nearly opaque moss agates generally adopt. The filaments, which are very irregular as to their size and mode of division, are variously bulged. They are pretty distinctly defined, without any nebulosity around them, and appear formed by knotty matter, of a dark-brown colour, filling numerous filiform and irregular canals, distributed without order in the calcedony. These infiltrations are very often irregularly anastomosed, which precludes all idea of a confervoid plant, since in the only cases in which similar anastomoses exist among the confervæ, they give rise to a very irregular net-work, as in the *Hydrodyction*, or to a mode of reticulation, irregular it is true, but very distinct from that of these infiltrations, and such as is observed in the conjugata, particularly in the *Zygnema genuflexum*. The only plants I know, whose irregular anastomoses resemble, in some respects, those presented by the infiltration in question, are in the genus *Rhizomorpha*, a genus which, in no other respect, has any resemblance to the infiltration of agates.

These brown infiltrations are the most frequent, but the most remarkable, on account of their agreeable appearance, and their resemblance, at first sight, to confervæ, are the green infiltrations. The matter, which forms them, appears much thinner than that of the brown infiltrations, so that it has, as it were, tinged the calcedony to some distance from the small canals in which the infiltration has been formed. There is also always seen, in the middle of the filaments, a more opaque line produced by a matter of a deeper green. This line appears to represent the small canal itself which traverses the calcedony. It is irregularly bulged at intervals, and the greenish nebulosity, formed by the infiltration of the colouring substance in the stone itself, has followed all the irregularities of this canal.

The more or less linear or strongly mammillated form of these infiltrations, and their greater or less opacity, appear to depend upon the extent of these canals, and the quantity of colouring matter which was contained by them. The aspect of these infiltrations also, the frequent anastomoses which they form, and their irregularity, preclude all idea of vegetable origin. Some gelatinous and tremelloid plants, such as the *Linckiæ*, *Mesogloiæ*, &c. have somewhat of this appearance, but they never affect this filamentary and anastomosing disposition, nor does examination with the microscope enable us to detect any analogy; for, with a magnifying power such as that which we employed, these plants presented characters of structure which immediately distinguished them.

These two forms of infiltration are those which are of most frequent occurrence in moss agates. I have observed another in a part of a slice filled with brown infiltrations, which left some doubts on my mind as to its origin. It presents a regularity in the filaments of which it is composed, and in their mode of division, which pretty distinctly suggests the idea of several confervæ, and, in particular, of certain species of the genus *Bangia*, such as *B. atrovirens* *. It is, however, possible, that it may be nothing else than a more regular infiltration, produced by very minute and regularly ramified canals. What would induce me to think so, is the mode of distribution of the opaque matter toward the centre of the filaments. In the confervoid plants, to which these filaments might be compared, the granular and coloured opaque matter fills the whole cavity of a thin and membranous tube. The transparent part, which is destitute of this granular matter, therefore forms on the edges but a narrow border, produced by the wall of the tube. Here, on the contrary, the opaque matter occupies a narrow central line, which appears to be the canal itself by which the colouring substance has penetrated; and all round this central thread there occurs a semitransparent layer, much thicker than a membranous tube would be, and which appears, as in the green infiltrations, to be the result of the infiltration of the colouring matter into the very substance of the stone. Notwithstanding its greater resemblance to a plant, I therefore am still of opinion that it is a mere infiltration. Thus the inquiries which I have made, have not, as yet, enabled me to discover in calcedonies well characterized plants, whether belonging to the group of Confervæ or to any other family.

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* Lyngbye, Tent. Hydroph. Danicæ, tab. xxv. fig. B.

As to the mode of formation of these infiltrations in the interior of calcedony, it forms no part of my object to account for it; and I leave to mineralogists to discuss the manner in which the small canals which are filled by the colouring matter are formed, the solid or gelatinous state of the stone at this period, and the nature of the matter introduced into it. My only object was to shew, that, in most cases, if not in all, the vegetable kingdom has nothing to do with these infiltrations; in other words, that they do not represent vegetables, and that their mode of branching even proves that the canals which occupy their axis, do not owe their origin to confervoid filaments, which these infiltrations may afterwards have enveloped, and caused to disappear. I know that the presence of confervoid vegetables in hot springs, which generally contain silica in solution, might have accounted for their presence in these stones; but the vegetables of hot springs are oscillatoriæ, a kind of confervæ, which, more than any other, differs from the infiltrations of calcedony, in having its filaments always simple, and most commonly straight, or only slightly flexuous.*—*Hist. des Vegetaux Fossiles*, 1*ere livraison*, p. 29.

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* We have observed vegetables in siliceous sinter from Iceland. Such specimens, when cut and polished, might, with the inexperienced, pass for calcedonies; and we believe such siliceous sinters are preserved in some cabinets, as arborescent calcedonies or mocha-stones.—Edit.

On the Occurrence of Fossil Remains of Mammalia in the Coal Formation of the Canton of Zurich.

M. Schintz, M. D., in August 1827, gave a general account to the Helvetic Society of Natural Science, of the fossil remains of mammifera discovered in the coal mines of the Canton of Zurich, and described the rocks in which the coal occurs. Bones have already been found in five places in the Canton itself, or near its frontiers, viz. at Hopfnach, on the Lake of Zurich; at Elgg near Buchberg, in the Canton of Schaffhausen; near Seelmatten on the frontiers of Thurgau and near Spreitenbach in Argau. A considerable quantity of the remains of mammifera have been found at Kopfnach, in the course of the last six years. They consist of two kinds of teeth of the narrow-toothed mastodon, of which three fore-teeth, and one from the bottom of the mouth, were presented to the Society; beavers teeth*, and those of two ruminating animals, of which one is scarcely larger than the teeth of the small musk, and another belongs to a species of deer, were also exhibited. The whole country of Kopfnach belongs to the tertiary formation. A regular series of sandstone, with limestone, containing much clay, gives to the whole a marly and easily decomposable property. This molasse formation occupies nearly the whole of the great basin lying between the Alps and Jura, extending about 100 miles in length from the Lake of Constance to the Lake of Annecy, and from 10 to 30 in breadth, and presents mountain chains from 1000 to 2000 feet high, and sometimes 1000 in breadth. Its depth may be about 3000 feet. It is in this formation that all the coal mines that are worked occur; and in these mines the animal remains have been found.

In the coal mine of Elgg, which has been worked about forty years, and of which the gallery is about 300 fathoms long, there have been found fragments of another species of mastodon, which does not correspond to any of those described by Cuvier, and which has only a distant resemblance in form to the great mastodon. The upper part of the gallery consists of a fine granular breccia, the lower part or floor of a soft sandstone, containing a considerable quantity of quartz, united by a calcareous base. The bed of coal is from eight to twelve feet thick, and the coal is often impregnated with bitumen. The carbonized bones occur near this bitumen, and are fragile. The large teeth have always three rows of tubercles, the small two. There have also been found the jaw of a rhinoceros, which belongs to the *Rhinoceros clausus* of Cuvier, and two long teeth of a singular form, which are certainly the foreteeth of an animal resembling the hogs and tapirs. These fragments were also presented.

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* Is there not some mistake here?—Edit.

Near Seelmatten, on the frontiers of the Canton of Thurgau, a bed of coal has been discovered, at a height of 600 feet above the valley; and since it has begun to be worked, there have been found a tooth of the small species of palæotherium, and another entirely unknown, without doubt the fore tooth of a pachydermatous animal. The two teeth were presented, but none of the members present knew the latter. The presence of the palæotherium proves, in Cuvier's opinion, that this coal formation is older than has hitherto been supposed; for he considers the palæotheriums as animals of very ancient creations.

There were also presented a jaw and some bones of an undetermined species of mastodon, taken from a colliery near Buchberg, and a small unknown bone from the Spreitenbach mines, near Dietikon, on the frontiers of the Canton of Argau.

It follows from the preceding details, that in all the collieries of the Canton of Zurich, there are found remains of antediluvian animals, much more rarely remains of vegetables. Trunks of large trees are distinctly seen only at Buchberg. At Kopfnach there is nothing but circular leaves, and at Elgg some indistinct fibres of roots. The state of carbonization, however, may be the cause that the vegetable substances are less distinct, since even the hardest bones are so easily broken.

Account of the Slip and Breaking-up of a vast Mass of Strata, on the Banks of the Whitadder in Berwickshire. In a Letter from DAVID MILNE, Esq. A. M. &c. to Professor JAMESON.

MY DEAR SIR,

A PHENOMENON occurred in this neighbourhood, a few days since, of which perhaps the following short account may not be unacceptable to you. Having yourself visited a part of the banks of the river Whitadder, you are probably aware that they consist entirely of the new red sandstone, with its marl and gypsum. From the peculiar nature of this formation, as well as the very prevailing abundance of clay, the soil is in general extremely friable, and readily crumbles to pieces by the united action of the weather and the river. The strata rise towards the north; and as the course of the Whitadder is from west to east, its banks, from this circumstance, are, on the south side, generally very steep, often perpendicular: while on the north side, they slope towards its edge with a much less precipitous and more regular descent. It is owing to the same geological conformation of the strata, that, with hardly any exception, all the rivulets, which flow into the Whitadder, are to be found on the north side, as the rains which fall upon the land on the opposite banks, taking their direction from the inclination of the strata, have rather a tendency to retire from the river. These rivulets have, in many places, worn away the friable soil composing the banks, to such an extent, that deep and narrow ravines have been formed, and consequently long and lofty ridges, consisting entirely of marl strata. Opposite to a small mill, situated on the south bank of the Whitadder, called Hutton Mill, there was one of these ridges which owes its origin to the cause just mentioned, one side of it being watered by a little brook usually dry in the summer, and the other side partly running along the edge of the river Whitadder.

This ridge rose to a height of about 120 feet above the level of the river; its length at the top may have been about 60 feet, and at the base 300 feet. Upon Tuesday last, 22d July, at three o'clock in the afternoon, this immense mass separated from its basis. The greatest part was impelled forward about 150 feet, and the whole hill was rent and broken asunder into a thousand pieces. Not a vestige remains of the former arrangement of the strata, and the channel of the river has been entirely choked with the aggregated ruins.

From the account which I have given of the situation of this hill or ridge, it is easy to discover the cause of the slip. During the dry and warm months of the early part of summer, large fissures had been formed in the clay and marly soil of which it is composed. During the late rain, which fell in such abundance throughout every part of the country, these cracks or fissures were, of course, suddenly filled with water; and all who are aware of the immense force with which a column of water acts, where it is of any considerable height, will understand how it may have contributed to loosen the friable texture of the strata. But the chief cause of this extraordinary slip I conceive to have been the rivulet already mentioned, which skirts the north side of the ridge, and by which, in fact, the ridge has in the course of time been formed. When this stream became swollen into a rapid torrent by the rains, and overflowed its narrow channel, the dry state of the soil allowed the water to percolate down freely through the marl strata, dipping towards the Whitadder; and thus, both by means of its physical force, and by rendering slippery the surface of the marl rock on which the ridge rested, it caused the superincumbent mass to slide down the declivity. The consequences of the operation of this very simple agent were inconceivably tremendous. An entire hill, consisting of solid strata, propelled forward from its basis, and severed into fragments, must have formed a spectacle of the most appalling grandeur. The noise of the crash must have been very considerable; as a young woman, working in the garden of the mill on the opposite side of the river, was so terrified that she sought her safety in flight, and attracted the neighbours to the spot by her screams.

About eighteen months ago a small slip took place also upon this side of the river, very near the spot I am now describing, and arising from the same cause. And I may remark, that, from the peculiar nature and position of the strata composing the north banks of the Whitadder, it is probable that this neighbourhood will very frequently witness a repetition of the phenomena similar to the one which has so recently occurred. I remain, my dear sir, yours very faithfully,

D. MILNE.

MILNE-GRADEN, COLDSTREAM,
29th July 1828.

Examination of the Experiments hitherto published on Subterranean Temperature, together with Experiments and Inquiries relative to this Examination. By M. L. CORDIER, Member of the Royal Academy of Sciences, and Professor of Geology in the Garden of Plants*.

THE experiments that have been hitherto published on subterranean temperature are of two kinds.

Some of them have for their object to examine the temperature of common springs, of rivers which issue directly from the earth in certain countries, of artificial fountains, of waters issuing from caves or galleries of drainage, intended for the drying of great mining works. These experiments are not numerous, nor, as we shall afterwards show, do they furnish any other than approximative data.

The object of the other experiments has been to determine the temperature of natural or artificial cavities, by means of which we are enabled to penetrate into the bowels of the earth. These experiments are numerous, and lead to results which have been regarded as precise. They have been pushed as far as from 1300 to 1600 feet. The following is a brief account of them:

In France, we have the experiments made in the caves of the Observatory of Paris, which were commenced about 150 years ago, and which have been perfected by M. Arago; those made by Gensanne†, in the metallic mines of Giromagny, about the middle of the last century; and those in 1806 by M. Daubuisson*, in the lead and silver mines of Poullaouen and Huelgoet in Bretagne. In Switzerland, we have the experiments made about forty years ago by De Saussure †, in the salt mines of Bex. In Saxony, those of MM. Freiesleben and Humboldt ‡, collected in 1791; of M. Daubuisson ‖, made in 1802; and especially those of M. de Trébra, in 1805, 1806, 1807, and 1815 §. In Great Britain, we have to mention numerous experiments made from 1815 to the present day, by Mr Lean, Mr Rede, and especially Mr W. Fox, in the copper and lead mines of Cornwall and Devonshire; and by Messrs Bald, Dunn, and Fenwick, in the coal mines of the north of England ¶. Lastly, we must also include into the number those made by M. de Humboldt in several mines in Peru and Mexico **.

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* Read to the Academy of Sciences, 1st June 1827.

† Dissertation sur la Glace, par Mairan; Paris, 1749, in 12mo. p. 60.

The number of mines in which these different observations have been made is upwards of forty; that of the individual markings of temperature is about three hundred.

Nearly two thirds of these markings of temperature have been made from the air contained in subterranean cavities, and most of the others from the water which presents itself in so many ways in these cavities. A very few are from experiments made with the view of directly determining the temperature of the rock surrounding the excavations; but several of these latter markings have the advantage of being mean temperatures taken from a great number of sedentary observations. With regard to the former, they all result from observations made on descending into the mines for a short time.

I take no notice of some less important observations which have been made in the mines, quarries, and caves of various other countries, because they have been made singly and almost accidentally. They refer, in general, to the temperature of the air of cavities; and, as the results have been similar to those which I am about to examine, the inferences at which I shall arrive are equally applicable to them.

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* Journal des Mines, t. xxi. p. 119.

† Voyages dans les Alpes, sect. 1088.

‡ Annales de Chimie et de Physique, t. xiii. p. 210.

‖ Description de Mines de Freyberg, tit. iii. pp. 151, 186, 200; Journal des Mines, tit. xi. p. 517; and xiii. p. 113.

§ Annales des Mines, tit. i. p. 377, and tit. iii. p. 59.

¶ Annales de Chimie et de Physique, t. xiii, p. 200; t. xvi, p. 78; t. xix, p. 438; t. xxi. p. 308; and Geogr. Distrib. of Plants, by N. J. Winch, p. 51.

** Annales de Chimie et de Physique, t. xiii. p. 207.

Such are the experiments whose merits we have to appreciate; and in doing this criticism has nothing to neglect. As it is proposed definitively to apply to the great the inferences deduced from the small, it is obvious that the slightest errors will have a prodigious influence upon what is to be inferred regarding the entire mass of the globe. Thus, for example, proceeding from the approximate law which is deduced from the experiments hitherto published, one degree of Fahrenheit of error more for a depth of 180 feet, in a given country, will raise to 1,600 feet (nearly half a quarter of a league), the point at which it is to be presumed that the temperature of boiling water exists under the place of observation. These considerations will be a sufficient apology for the details into which I shall sometimes be obliged to enter.

By means of the precautions to which I have had recourse, I trust that my own experiments may be regarded as sufficiently accurate. Most of them were made in three coal mines in France, very distant from one another, which I selected as presenting the most favourable circumstances, and which are: 1st, the mine of Littry, situated eight miles W. SW. of Bayeux, in the Department of the Calvados, and of which the openings have an elevation of about 200 feet above the sea; 2dly, the mine of Decise, situated seven and a half miles to the north of the city of that name, and of the banks of the Loire, in the Department of the Nievre, and of which the elevation above the sea is about 490 feet; 3dly, the mine of Carmeaux, situated in the Department of the Tarn, eight miles to the north of Alby, and nearly 820 feet above the sea. I shall revert to the local circumstances of these mines as I proceed. At present it is sufficient to add, that my experiments took place, in the first in August 1823, in the second in September 1825, and in November 1822 and September 1825 in the third. In all, I made use of mercurial thermometers, which I carefully proved and compared with one another, and which, in all cases, where I shall not mention the contrary, were applied with the ball naked. With the kind assistance of MM. Arrago and Mathieu, I have been enabled to reduce all my results to the graduation of the normal thermometer of the Observatory of Paris, centigrade division. This division is also that which I have used in all parts of this memoir.

With these explanations, I now proceed to the examination of the experiments which have been made on the temperature of the air contained in mines.

1. *Temperature of the Air in Mines.*—The experiments on the temperature of the air of mines would be unobjectionable, and we would have reason to suppose that they give the exact temperature of the zone of rock in which they have been made, had their circumstances been similar to those of the caves of the Observatory of Paris, that is to say, had they been made in excavations of small extent, and especially of little height, situated in the original rock, defended by a sufficient closure from all foreign influences, such as the passage of workmen, the access of water, the introduction of external air, and shut up for a length of time sufficient to allow the original temperature of the walls to be completely re-established. But none of these observations have been made in such favourable circumstances.

To appreciate the various kinds and degrees of inaccuracy to which they have all been subjected, we shall first consider what might take place in a mine, which we shall suppose of some extent, composed of several stages, free of filtrations, and which has been kept hermetically shut since the period at which it was abandoned. The air in each stage would assume the temperature of the surrounding rock. This air, upon the hypothesis which we maintain of a heat increasing in the earth as the depth increases, would continually circulate from the lower to the upper stages, and *vice versa*, on account of the differences of specific gravity, arising from the inequality of the heat which would take place at each level. These continual motions would be the more lively, the wider and less sinuous the subterranean canals were, and the greater the number of their communications. In the opposite case, the displacement of the air would be produced slowly, especially at the most remote extremities of each stage; and it would happen, that, towards these extremities, the temperature of the air would not differ much from that of the surrounding rock. In this case, and still more in the former, the temperature of the air would never exactly represent in any point the temperature of the rock in contact with it.

If the identity of the temperatures in question cannot occur in such a mine as we have imagined, still less possible is it in common mines, to which the air has continual access, in which the filtering waters incessantly act as a cause of variation, and where the lights and workmen daily disengage large quantities of heat. Let us examine the effects which these three disturbing causes produce upon the temperature of the air contained in mines.

The external air, by continually mixing with the air contained in a mine, acts in the ratio of the temperature which it brings to each point, and of the mass which is introduced at this point in a given time. Now, these two elements are continually varying, and their influence necessarily extends to the most distant excavations. I estimate the velocity of the draught which takes place by means of the shafts that serve for ventilating mines, as being sometimes four times and even six times as great when it is very cold as it is in ordinary weather. The temperature of the air which enters varies every day, every hour, or it may be said every moment. This temperature is lowered more or less, from the effect of the more or less abundant evaporation which the air produces, by reason of its dryness and original heat, in proportion as it circulates along the humid surface of the excavations. At the same time it is subjected to a very feeble cause of augmentation, which seldom compensates the preceding, and which depends upon the increasing influence of the atmospherical pressure, in proportion as the air introduced penetrates into deeper cavities. This cause, the effect of which has been exaggerated by some persons, could only augment the temperature of the introduced air, about five or six-tenths of a degree of Fahrenheit for a depth of 180 feet.

These data justify the proposition which precedes them. Further, there results from them a curious fact, which it is of importance to establish; namely, that the mean temperature of the *mass of air* which has been introduced into a mine in the course of a year, is certainly inferior to the mean temperature of the country for the same year. According to various researches, which it would occupy too much time to relate, I estimate the difference as being from three to five degrees Fahrenheit, in most of the mines of our climates. Thus, not only does the introduction of external air into a mine increase and diminish incessantly, and in a more or less sensible manner, the temperature of the air contained in the different parts of each stage, but it also tends ultimately to lower the proper temperature of the whole excavations, and this in a necessarily unequal manner in the different parts situated at the same level.

The second disturbing cause, the filtering water, acts in a uniform manner, whether we consider its action in a very short, or in a very long period. It also tends to diminish the temperature of the air contained in the excavations in which it occurs. It depends upon the influence of the proper heat of the affluent waters. Now, it will be seen hereafter, that these waters arrive at the point where they make their exit, with a temperature acquired in more elevated zones of rocks; consequently, the surfaces which they cover in each excavation, communicate to the air in contact a temperature lower than that of the surrounding rock.

The third disturbing cause, viz. the heat disengaged by the workmen and the lights they use, exercises an influence the reverse of the preceding, an influence often powerful, and which has not yet been calculated, although it has served as a basis to several persons for denying the consequences deduced from experiments made upon subterranean temperatures. It is essential to value its effects approximatively by numbers.

According to the interesting researches of M. Despretz on animal heat, a middle sized man disengages, in twenty-four hours, by respiration, a quantity of heat equal to that which would raise 1 ounce of water to 205,709° Fahrenheit, and this heat is only three-fourths of the total heat produced in the same period, by the same individual. Whence it follows, that the total heat which is disengaged in an hour, is equivalent to what would raise 4640 pounds of water (in round numbers), to 1° Fahrenheit. Making use of the proportion (1,0000 : 2,669) which, according to MM. de La Roche and Bérard, expresses the difference of the specific heats of water and air, and setting out from the specific gravity which air possesses at 54° Fahr. of temperature, it is definitively found, that a miner disengages hourly a quantity of heat capable of raising 1° Fahr. 34,456 cubic feet of air, taken at 54° Fahr. of original temperature.

The heat produced by the lighting presents two cases, according as oil or candles are employed.

I compare the oil of the miners' lamps to linseed oil, in regard to its manner of burning. Now, according to Count Rumford, the combustion of 1 ounce of linseed oil, raises the temperature of 1 ounce of water to 16°.28 Fahrenheit. Making use of the same data as the above, we find that in one hour, the presence of a lamp burning 15 grammes of oil (as at Carmeaux, for example, where coarse walnut oil is employed), increases, by 1° Fahrenheit, the temperature of a mass of air of 26,000 cubic feet, taken at an original temperature of 54° Fahrenheit. Thus four of these lamps produce about as much heat as three workmen.

Count Rumford found, that the heat furnished by the combustion of 1 ounce (gramme) of tallow, raised 1 ounce of water to 15.064° Fahrenheit; whence it follows, that in one hour the light obtained (as at Littry, where the candles are from twenty-eight to thirty-two in the pound) by the consumption of 7½ grammes of candles, raises 1° 12,015 cubic feet of air, taken at the original temperature of 54° Fahrenheit.

According to these data, the presence of two hundred miners, and two hundred lamps suitably distributed, would suffice to raise 1° Fahrenheit in an hour, the temperature of a mass of air equal to that which a gallery of 3 feet by 6 feet, and 656,900 feet (about 124 English miles) in length, would contain. It is not without reason, therefore, that the presence of workmen and lights has been alleged necessarily to exercise a great influence upon the temperature of the air of mines. In general this influence tends, during the greater part of the year, to counterbalance more or less completely the effect of causes which might keep the temperature of the air contained in an excavation, beneath the proper temperature of the surrounding rock. During the rest of the time it augments the excess of the temperature of the air, over that of the rock with which it is in contact at each stage. It acts, besides, in the most variable manner, according to the number and distribution of the lights and workmen, the capacity and depth of the works, and the manner in which it combines with the two first causes of disturbance which we have explained. There is nothing more changeable than these combinations. There evidently results from them a multitude of motions, of particular currents, and counter currents, almost always unperceived by the miner, which extend into all the parts of the excavations, and without which, I now believe, that the ventilation of mines would be very imperfect. I calculate, besides, that, in more than one important mine, when the external temperature is from 68° to 77° Fahrenheit, the air which is introduced in the course of an hour is not equivalent to the hundredth part of that which fills the excavations.

To support the observations which I have just expressed, I shall relate the result of some experiments.

On the 9th November 1822, at seven in the morning, when I descended into the working called the Ravin, in the mine of Carmeaux, the external air six feet above the surface of the ground was 56°.1 Fahrenheit. Five hours after, when I returned, it was 58°.8 Fahrenheit.

A single shaft which, not including the *puisard*, was 482 feet deep, cleared the whole works. At the middle of the entrance of this shaft, the air entering at the same hours as above marked 2°.2 Fahrenheit more than without. Thus it was already mixed with the warm air, which arrived in an insensible manner from the bottom of the works.

The works were intended to prepare the extraction of two thick beds of coal, nearly horizontal and parallel, and at an average 98 feet distant from one another. They consequently consisted of two stages, formed each of wide galleries, crossed at right angles, and traversed by a principal waggon way. These excavations, the digging of which had been pursued with constant activity for seven years and a half, were then very nearly 558,450 cubic feet in extent. The ventilation was effected in the usual manner. From the surface of the section of the ventilating chimney, and the velocity of the air which issued from it, I found that the quantity of air introduced into the mine in an hour was only 3705 cubic feet, that is to say, it was not equivalent to the twelve thousandth part of the mass contained in the excavations.

Nineteen lamps and twenty-four workmen distributed in the two stages, were constantly employed during six days of the week, and produced hourly a heat capable of raising 2°.99 Fahrenheit the temperature of a mass of air equal to that which filled the whole of the galleries.

At the upper stage, the temperature of the air taken in the waggon-way, at an equal distance from the sides, the ball of the thermometer being suspended at a height of one foot from the rock forming the roof, was as follows: 69°.3 Fahrenheit near the shaft; 72° Fahrenheit, a hundred and forty metres farther on, that is to say, near a shaft forming a communication for ventilation between the two stages; and 73°.8 Fahrenheit at the extremity of the gallery, that is to say, at a distance of 790 feet from the shaft. Proceeding in the same manner, I found at the extremity of several galleries, whether parallel or cross, a temperature varying from 73° to 73°.8 Fahrenheit. The workmen, besides, had not entered the galleries for some time; the air was perfectly stagnant, at least to appearance; and, according to the commonly received ideas, their temperature seemed calculated to give that of the surrounding rock.

At the lower stage, proceeding in the same manner as above, I found that the air at the bottom of the principal waggon-way, that is to say 900 feet from the shaft, marked 74°.1 Fahrenheit. At the extremities of the other galleries into which I entered, the temperature was only from four to five tenths lower than the above. At the roof of the canal ending in the ventilating chimney, the ascending air was 73°.6 Fahrenheit, and consequently issued with a temperature more than 14° Fahrenheit above the external air.

Lastly, having determined in a direct manner, which I consider as accurate, and of which I shall give a description afterwards, the proper and original temperature of the rock which surrounded the bottom of the lower waggon-way, I found it 62°.8. Thus I would have committed an error of nearly 11° too high, had I, in imitation of most observers, given the temperature of the air of the unfrequented galleries of the lower stage of the Ravin mine, as representing the real temperature of the zone of rock, which is situated in the same horizontal plane.

The example which I have just adduced, is so striking that I believe it useless to relate the numerous facts of the same nature, which I have collected at Littry and Decise.

In the course of my investigations in the mines just mentioned, as well as in several others to which I have extended my researches within these six years, I determined another not less interesting fact, namely that, at the same time, the temperature of the air is scarcely ever the same at the lower and upper parts of a gallery, or any other work of the same kind. In a height of less than six feet, I sometimes found differences of 5° or even 7°. At the Ravin mine, for example, in the whole extent, and at the extremities of the unfrequented galleries, the thermometer, placed at a distance of 8 inches from the floor, marked from 16 to 22 tenths Fahrenheit less than near the roof. At the extremity of the waggon-way of the lower stage, the difference was 3°.4. This remarkable difference prevailed over a great extent, and as a considerable slope favoured the passage of the cooled air toward the ventilating chimney, there resulted at the floor of the gallery, a current which could be rendered sensible by means of a little smoke *, and which supplied the defect of communication between the extremities of the two stages. The warm air which occupied the upper part of the gallery had a motion in the contrary direction, and flowed to undergo the effect of cooling which the freshly exposed surfaces at the extremity of the perforation operated upon it. The same effects took place at the upper stage, which made the workmen entertain the apparently absurd opinion, that the air came from the bottom of the works.

The last mentioned experiments are also those which have contributed the most to make me discover that the influence of the causes which occasion the temperature of the air in mines to vary incessantly, assuredly extends to the bottom of the most distant works. The consequences which are to be deduced from them with reference to the merit of the observations under discussion, are too evident to require any particular exposition. Thus,

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* To appreciate the direction and velocity of the currents of air in mines, there may be employed with great success, the smoke produced by the deflagration of a mixture formed of well pulverized metallic antimony and gunpowder, in the proportions of two to five. This mixture, which was pointed out to me by M. D'Arcet, was put to the proof by the commission of which we formed part in 1826, for the curing of the sewers of the City of Paris. It will be almost always sufficient in mines to burn a very small quantity of it.

for example, before attributing, as has been done, an absolute value to these observations, it were necessary to solve this first question. In a gallery, or in any other excavation, what is the stratum of air whose temperature is thought to represent that of the surrounding rock?

From all that we have hitherto related, it may be concluded with certainty, that none of the observations collected on the temperature of the air in mines, exactly represent the proper temperature of the zone of rock at whose level it was made. Supposing that, by a concurrence of extremely improbable compensations, some of these observations having taken place at the moment when there existed an identity of temperature, nothing could apprise us of so fortuitous an accuracy. None of them, therefore, is capable of being compared with the mean temperature of the country in which it has been made. Those which have been obtained at different levels in the same mine, on the same day, and at not many minutes distance, are not more capable of being compared with one another, although in general they are more useful to be consulted than all the others. No other use, therefore, can be made of this mass of observations than as mere documents.

It must be confessed, that, even in this view, most of them leave a considerable degree of uncertainty, for, in publishing them, their authors have only made known a small part of the details which would have been necessary for the establishment of their real value. There is but a small number which, after being submitted to the scrutiny resulting from the principles exposed above, could be regarded as giving a temperature either nearly the same, or certainly inferior to that of the level to which they refer. The observations of this kind are those which have been made during cold weather, or in circumstances entirely exceptionable; for example, in excavations of small extent, although deep, dry, and long deserted. Now, these observations all proceeded in the same direction, and although they can only be considered as approximative, yet they positively indicate the existence of a certain increase of heat proportional to the depths.

We consider it useless to mention these latter observations in detail, because it will be easy to distinguish them in the midst of all the others of the same kind that have been published, and because we shall presently discover the existence of better proofs. These conclusions certainly are not without interest; but they are far from being so satisfactory as there was reason to expect from the number of experiments that have been made, and the perseverance which several observers have applied to them. We are indemnified to a certain degree by the exception which is to be made in favour of the experiments of the same kind, but sedentary, which have been carried on for so long a time in the old quarries called the Caves of the Observatory of Paris. These are conclusive, and are capable of yielding a numerical and absolute result. Their accuracy affords a compensation for the small depth which they embrace. They incontestibly announce a pretty rapid increase of the subterranean heat. At the level of 92 feet, the mean temperature of a thermometer immersed in a recipient filled with sand, and supported by a pillar, keeps at 1°.8 beneath the mean external temperature. In the course of a year, the variations of the thermometer do not exceed $\frac{1}{83}$d of a centigrade degree.

Such is, in fine, the merit of the experiments that have been made upon the temperature of the air in the cavities, by means of which we can penetrate into the bowels of the earth. We shall now examine whether the results that have been obtained by proceeding in a different manner, and especially by consulting the temperature of the waters which exist in mines, present more numerous or more certain resources, with reference to the object which we have in view.

2. *Temperature of the Water in Mines.*—Water presents itself in various ways in mines. Here it issues from the rock under the form of filtrations, more or less copious; there it traverses the bottom of the excavations in small brooks. Elsewhere it is stagnant, and constitutes pools or true subterranean lakes.

Not viewing the observations which have been made on the water thus contained in mines, otherwise than as merely forming a mass of approximative documents, we may yet, without hesitation, conclude from them that there exists a notable increase in the subterranean heat. In fact, the experiments were made at different seasons, and the results are all higher than the mean temperature of the country where they were performed. The differences increase rapidly as the depth increases. Whatever influence may be attributed to the summer rains, with reference to the temperature of springs and filtrations, to the air during warm weather, or to the lights and the presence of the workmen, with respect to the running or stagnant waters, there is yet remaining a great number of observations, whose testimony cannot be refused. The consequence above stated appears therefore incontestible; but it is all that can be drawn from the experiments. Thus, as we shall presently see, the numbers which they furnish cannot be regarded as sufficiently accurate to enable us to deduce from them, in a certain and absolute manner, the law of the increase of temperature in depth; some of them would make it too high, and others too low.

As it is, however, a great step gained to be assured that there is an increase, and that this increase is probably rapid, it is essential to take in here the result of an experiment of Mr W. Fox's, which is much more important than it seems at first sight, and which would have had much more interest, had not the author omitted to relate several circumstances which he had done well to have made known.

The waters which issue from most of the numerous tin and copper mines of Cornwall, are led by means of various branchings into a great adit, which conducts them above the valley of Carnon, and which, at its termination, pours forth 1400 cubic feet of water per minute, amounting to about 60,000 tons in the day. In one of the branches leading to the great adit, the water of six mines, from 900 to 960 feet deep, Mr Fox, at half a mile from its mouth, found the water at 73° 4′ Fahr. In a second branch, leading off the water of ten mines, having a mean depth of from 660 to 720 feet, the temperature was 66° 6′ Fahr. at a third of a mile. In a third branch, which drains seven mines, whose mean depth is from 600 to 660 feet, the water marked 64° 9′. Lastly, the temperature of the united streams, taken at the mouth of the great canal or adit, was found to be 69° 3′ which is 10° 7′ cent. above the mean temperature of the country. In the second place, it may easily be proved, by means of the data which we have already enumerated, that it is independent of the influence which might, in other cases, be attributed to the lights and the presence of the workmen. In fact, if it be admitted that the working of the mine requires the constant employment of 2000 workmen, and 2000 lamps, burning each one-half ounce of oil in the hour, it will be found, that, in one hour, the heat produced by the lights and workmen will scarcely suffice to raise one-half a degree Fahr. the temperature of a mass of water equal to that which has flowed off in the same period. In short, whatever may have been the temperature of the air which may have been for an hour in contact with the waters drained off, it is not possible that it could have communicated to them a quantity of heat so superior to that of which they would have been deprived, in consequence of their filtration through the rocks covering the mines, were there no central heat.

These data being laid down, I come now to the examination of the different experiments considered under the point of view of the assistance which may be derived from them in determining the law which the increase of the subterranean temperature follows.

There is an infinity of chances against the water of filtrations and springs manifesting a temperature perfectly equal to that of the rock from which they issue. In fact, the original heat of the rain-water which penetrates into the soil continually varies, being sometimes superior and sometimes inferior to the mean temperature of the country. These differences are often very great during a whole season. Moreover, the original heat is subjected to many modifications, which depend upon the depth to which the waters descend, the number and length of the canals, the slowness of the circulation, the length of time that it has been established, and the number and extent of the masses of water traversed, if there be any such in the lines of passage. These elements are very complicated, and it would be necessary to possess their expression, in order to appreciate the merit of their result which each experiment furnishes. This, however, we cannot have. All that we are permitted to conclude is, that most of the experiments are probably very approximative, and that they give in general temperatures lower than those of the zones of rock at whose level they have been made, especially when the depths are considerable. I say in general, for, in strictness, it might be possible that the water of a spring, or filtration in a mine, had passed along canals descending much more deeply than the orifice from which it issues, and had time to acquire the temperature of these canals; it might also be the case that it had passed through old works, in which the rubbish had undergone decompositions capable of producing a certain degree of heat; but these cases must be very rare. According to the above, the following table, containing thirteen observations made in Saxony, France, England, and Mexico, may be consulted, as presenting useful documents, although no absolute result can be deduced from them, with reference to the subject in question.

TABLE of Observations made on the Temperature of Puisards (or waste wells) in Mines.

Places, Authors, and Dates of Observations.	MINES.	Depth of the Stations.	Temperature, Fahr.		Depth corresponding to the increase of 1 degree of heat.
			Of the Springs.	(Mean) of the Country.	
		Feet.			*Feet.*
SAXONY, Daubuisson, End of Winter in 1802.	Lead and Silver Mine of Junghohe-Birke,	256	48° 9	46° 4	102.4
	Lead and Silver Mine of Beschertglück,	712	54 5	46 4	87.9
		840	56 8	46 4	80.7
	Do. of Himmelfahrt,	735	57 9	46 4	63.9
BRITTANY. Daubuisson, 5th September 1806.	Do. of Poullaouen,	128	53 4	52 7	182.0
		246	53 4	52 7	351.0
		459	58 3	52 7	82.0
	Do. of Huelgoët,	197	54 0	51 8	89.5
		262	59 0	51 8	36.4
		394	59 0	51 8	54.7
		755	67 5	51 8	48.1
CORNWALL, Mr Fox, Pub. in 1821,	Copper-mine of Dolcoath,	1440	82 0	50 0	45.0
MEXICO, Humboldt,	Silver-mine of Guanaxuato,	1713	98 2	60 8	45.8

According to this table, the depth corresponding to the increase of 1° Fahr. of temperature would be in round numbers as follows: By four observations made in three mines in Saxony, from 102 to 64 feet, mean 83 feet; by three observations at Poullaouen, from 351 to 82 feet, mean 206 feet; by four observations at Huelgoet, from 90 to 36 feet, mean 57 feet; by one observation at Dolcoath, 45 feet; and by one observation made at Guanaxuato, 46 feet.

(To be concluded in next Number.)

Sketches of the Meteorology, Geology, Agriculture, Botany and Zoology, of the Southern Mahratta Country.* With a Map. By ALEXANDER TURNBULL CHRISTIE, M. D. Communicated by the Author.

General Description.

THE district of Darwar, in the southern Mahratta country, is of an irregular triangular shape; the apex of the triangle being towards the south, in north latitude 14° 20′, and its base towards the north, on an average, in 16° 23′. Its most westerly point, towards the Goa territory, and which forms one of the angles at the base, is about 74° 5′ east longitude; and its most easterly point, which is the remaining angle, is in east longitude 76° 22′. It is bounded on the north by the Kolapore country, and the river Kistnah; on the east by the Hydrabad country, and the Honourable Company's district of Bellary; on the south by Mysore; and on the west by Soonda, (a district of Canara), and by the Western Gauts, which divide it from the Goa territories. Within these boundaries, besides the British possessions, are many separate tracts, belonging to independent Jagheerdars, and tributary chieftains of different denominations; but so subdivided and varied in their outline, that it would be nearly impossible, and of little use, to give a description of them.

The following observations are not exclusively confined to the Darwar district; but sometimes extend to that of Canara, and to the Portuguese territory of Goa, and thus occasionally embrace the whole tract of country from the Tumboodra to the coast.

The Darwar district is very generally known in India by the name of the Southern Mahratta Dooab; which name it has received, from the circumstance of its extending between the rivers Kistnah and Tumboodra. But this term properly includes the whole tract of country eastward, to the junction of these two rivers, and thus embraces a considerable portion of the Nizam's dominions. When this term occurs, therefore, in the course of the following observations, it is to be understood in the above extended sense.

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* The observations on the Southern Mahratta country were made during my residence in that part of India.

The Gauts above Goa, and which form part of the western boundary of the district, have an elevation of 2500 or 2600 feet, above the level of the sea, whence the country gradually slopes to the Tumboodra, which is about 1500 feet above the level of the sea *. In this part of India, there is nothing like mountainous scenery, except immediately under the western face of the Gauts; for as soon as you attain their summits in proceeding eastward, you are on the inclined plain which shelves to the eastern coast; and the general declination of which, is only interrupted by gentle hills, which seldom attain a height of above two or three hundred feet.

Immediately to the east of the Gauts, the country continues hilly for about thirty or forty miles; the hills being covered with wood, which becomes gradually thinner, and more stunted, towards the east. Beyond this hilly tract, as far as the eastern frontier of the district, the country consists of extensive plains, intersected in different places by long narrow ranges of sandstone hills, with even summits.

This particular configuration of the country, gives rise to striking peculiarities in its climate; and, consequently, in the vegetable and animal productions of its different parts. This circumstance renders it susceptible of a very natural division into three distinct parts; viz. into the western or hilly part, the plains which occupy all the central and eastern parts of the district, and the ranges of sandstone hills, which intersect these plains.

The summits and western face of the Gauts afford, in many places, the most savage, and, at the same time, beautiful scenery. A boundless forest of gigantic trees, with the utmost variety of foliage, covers the highest hills, and penetrates into the deepest recesses of the valleys. In some places, enormous masses of black rock, which appear to have been rent from the neighbouring hills, rise high over the tops of the woods, and form a fine contrast to the rich green of the surrounding foliage. Wherever

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* The different altitudes which are stated in the following observations, were ascertained by Major Cullen of the Madras Artillery, by barometrical measurement.

the forest opens a little, so as to admit of the growth of humbler plants, the ground is covered with the most luxuriant grasses, and flowers of the richest hues. The stillness of this wilderness is only interrupted by the sleepy sound of a mountain stream, or occasionally by the harsh cry of some solitary birds, or the loud hollow voice of a monkey. Animals are seldom met with; and often on your journey, nothing is to be seen for hours but an endless luxuriant vegetation.

Some very beautiful waterfalls are met with in the western Gauts, but many of these are completely dried up in the hot season. There are very fine falls in the Gauts above Honoor, which, for sublimity and magnitude, will probably yield to few in the world. They have hitherto been little known even to Europeans in India; and it is, I believe, only within the last ten or twelve years that they have received a name. They are situated on the river Shervutty, about fifteen miles up the Gauts, from the town of Garsipa. They are now known to Europeans by the name of the Falls of Garsipa. I visited them in the month of October 1825.

The country in the neighbourhood of the Falls is extremely beautiful, combining the majestic appearance of a tropical forest with the softer characters of an English park. Hill and dale are covered with a soft green, which is finely contrasted with a border of dark forest, with numerous clumps of majestic trees, and thickets of accacias, the carunda, and other flowering shrubs.

Upon approaching the Falls, you emerge from a thick wood, and come suddenly upon the river, gliding gently among confused masses of rock. A few steps more, over huge blocks of granite, bring you to the brink of a fearful chasm, rocky, bare, and black; down into which you look to the depth of a thousand feet! Over its sides rush the different branches of the river, the largest stretching in one huge curling pillar of white foam, without interruption to the bottom. The waters are, at the bottom, by the force of their fall, projected far out in straight lines; and at some distance below the falls, form a thin cloud of white vapour, which rises high above the surrounding forest. The sides of the chasm are formed by slanting strata of rock, the regularity of which forms a striking contrast to the disorder of the tumultuous waters, the broken detached masses of stone, and the soft tint of the crowning woods.

The effect of all these objects rushing at once upon the sight, is awfully sublime. The spectator is generally forced to retire after the first view of them, in order gradually to familiarize himself with their features; for the feeling which he experiences upon their sudden contemplation, amounts almost to pain. After their first impression has somewhat subsided, and he has become accustomed to their view, he can then leisurely analyze their parts, and become acquainted with their details.

The chasm is somewhat of an elliptical form. At its narrowest and deepest part is the principal fall; and over its sides smaller branches of the river and little rills are precipitated, and are almost all dissipated in spray before they reach the bottom. The principal branch of the river is much contracted in breadth, before it reaches the brink of the precipice, where it probably does not exceed fifty or sixty feet, but it contains a very large body of water.

The Falls can only be seen from above, for the precipices, on both sides of the river, afford no path to admit of a descent. Some gentlemen have attempted to reach the bottom by having themselves lowered by ropes; but no one, to my knowledge, has hitherto succeeded. A view of the Falls from below would, I am convinced, exceed in grandeur every thing of the kind in the world. The spectator can very easily, and with great safety, look down into the chasm to its very bottom. Some large plates of gneiss project, in an inclined position, from its edge; so that by laying himself flat upon one of these, he can stretch his head considerably beyond the brink of the precipice.

No accurate measurement has yet been made of the height of these Falls. Some who have seen them declare, that their height reaches at least 1100 feet; others, that it does not reach 1000. I prepared a rope 900 feet long, attached a stone to one end of it, and let it slip over the edge of a rock, which projects several feet beyond the side of the precipice. When 500 feet of rope had been let out, the stone was forcibly drawn towards the principal cascade, which soon involved it among its waters, and snapped the rope. The stone at this time appeared to be about 200 feet from a small ledge of rock, which might be between 200 and 300 feet from the bottom. It is not improbable, therefore, that the height of the fall is not much short of 1000 feet.

We shall now return to the description of the Darwar district. It has been stated above, that it may be divided into three parts, viz. the western or hilly part; the great plains in the central and eastern parts of the district; and the sandstone hills which intersect these plains.

The boundary between the plains and hilly tract is very irregular. Proceeding from the east, a few insulated low ranges are first met with, having a general direction of north-west and south-east. The hills continue in parallel ranges with the same direction, for many miles to the westward. But when within six or eight miles of the summit of the Gauts, the scenery assumes a more irregular character, the hills being heaped more together, with steeper sides, and more irregular forms. The rugged and wild features of mountainous scenery are nowhere met with; for the hills are generally somewhat rounded, are softened with a rich vegetation, and resemble, in their general character, the hills of Cumberland, or those between Geneva and Lyons.

The second division, or the plains in the central and eastern parts of the district, are precisely similar to the extensive plains of cotton ground met with in every part of India. They are almost entirely in a state of cultivation. During the rainy and cold seasons they are covered with luxuriant crops. The regularity in which these are planted; the great variety of colours produced by the numerous kinds of grains, pulses, oil and cotton plants, and the great extent over which they are spread; afford an appearance of riches and prosperity. In the hot months the scene is entirely changed; you then look around on an arid plain, whose deep black soil is every where intersected by wide fissures. Not a patch of verdure, not a tree or shrub, is to be seen. Clouds of dust are swept along by the parching wind; or huge pillars of it, raised up by whirlwinds to the height of a hundred feet, are seen stalking across the plain; or (if the atmosphere be calm) fixed for a length of time to one spot. This cheerless view is only terminated at a distance by a line of sandstone hills, whose even summits give them the appearance of a great wall. The sun, now nearly vertical, produces a painful glare, and every living thing is overcome by the oppressive heat, not even the hum of an insect being heard.

The sandstone tract occupies all the northern parts of the district. It commences to the east of Gudjunderghur; whence it extends north to the Kistnah. Its southern boundary runs from Gudjunderghur through Julleal and Konoor to Pursghur; whence this tract extends, with some interruptions, north to the Kistnah, and north-west to Gokauk, Padshapore, and into the Kolapore country. Within this tract, however, are many extensive plains of cotton ground. The sandstone hills are invariably in long ranges, the general direction of which appears to be north-west and south-east. Many of the valleys between these ranges possess a soil of pure sand, the debris of the neighbouring hills. The hills are generally bare; and where they possess a slight covering of soil, produce only a few stunted shrubs, consisting principally of cacti, mimosas, and the cassia auriculata.

Another range of hills of much less extent than the sandstone hills, and which could not be included in any of the above divisions, deserves to be noticed in the physical geography of the district. It is called the Kupput-Good-Range. It consists of granite and schists; and extends from near Guduk, in a south-east direction, as far as the Tumboodra. Were it not for this range of hills, the cotton ground plains would extend uninterruptedly from the southern extremity of the district to Gudjunderghur and Konoor.

Five rivers water this district, viz. the Kistnah, the Tumboodra, the Gutpurba, the Mulpurbah, and the Wurdah. The two first are by far the most considerable, and form the northern and southern boundaries of the district. The three others are reduced to comparatively small streams in the hot season. They all take their rise in the Western Gauts. Besides these, there are numerous streams, or nullahs, as they are called, the most considerable of which is the Beyny nullah, which has its source among the hills in the neighbourhood of Miscreecottah, flows northward through the black plains, and falls into the Mulpurba. Most of these nullahs are dried up in the hot season.

These rivers and nullahs, except in the western parts, are devoid of beauty; being sluggish and muddy. They cut their way through the deep cotton ground, which, in the dry season, forms precipitous banks, deep, black, and bare; and thus, in many places, the river has more the appearance of a great artificial ditch, than of a natural stream. The banks, which in many places are from twenty to thirty feet deep, are often overflowed during the rains. Nowhere are to be seen the sloping banks covered with verdure, with trees and flowers, which make river scenery so beautiful in temperate climates.

Meteorology of the Southern Mahratta Country.

The most opposite climates are met with in different parts of the southern Mahratta country; for the western parts, towards the Gauts, may be reckoned among the wettest parts of the Indian peninsula; and the eastern among the driest. The average quantity of rain in the latter may be reckoned at from 20 to 26 inches; in the former, a larger quantity than this often falls within one month *. The climate becomes gradually drier as we proceed eastward, from the chain of the western Gauts; and as this chain runs N.NW. and S.SE. we have consequently a drier climate in the northern parts of the district, than in the southern, on the same meridian. Thus, at Soondah, the climate is rainy and cool; at Gokauk, on the other hand, which is in the same longitude, it is dry and hot.

A considerable quantity of rain falls as far eastward as the country continues hilly; but beyond this the supply is scanty and precarious. In August 1824, a good deal of rain fell at Darwar; while, at the same time, not a drop had fallen fifteen miles to the east, and the wells there were nearly dried up. For three weeks in July and August this year (1827), nearly incessant rain fell at Darwar, and during the same time, not a drop fell in the eastern parts of the district.

The difference in the habits and mode of life of the inhabitants of the western and eastern parts of the district, abundantly testifies how very opposite are their respective climates. In many places, the former are often for weeks during the monseen confined to their own villages or huts, not only by the severity of the rains, but in many instances by the stoppage of their communication by the swollen nallahs. During this dreary period, (in anticipation of which a stock of provisions is always laid in as a ship is supplied for a voyage), the inhabitants sit round a fire in the centre of their miserable dwellings, which are thus constantly filled with smoke. When they do venture out in this weather, they wrap themselves in a cumly*, and over this they place " a sort of thatched case or shell, made of the leaves of the jar †, or some other of the palm tribe. It is broad over the whole back and shoulders, narrowing to a peak immediately over the head, and coming down the front over the face, just so far as is necessary to give it a firm hold, with a slope sufficient to carry the water that falls on it clear of the body ‡."

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* Vide Statistical Report of part of the Southern Mahratta Country, by the late Dr Marshall.

In the eastern parts, it is very different. The rain is seldom so severe as to prevent the inhabitants from going out for four and twenty hours at one time:—and there, precautions against heat, not against cold, are necessary.

The villages in the western parts consist of thatched huts, whose steep sloping roofs nearly reach the ground, the walls being only a few feet high, that they may be effectually protected from the rain. Every spot is covered with vegetation. Hedges and trees covered with twining plants line the roads, and the thatched roofs are often concealed by creepers, generally cucumbers, pumpkins, &c.

The villages in the eastern parts present a curious contrast to the above. Generally not a spot of green, for many months in the year, relieves the horrid glare. All is parched and brown. No protection being required against heavy rain, the houses are built entirely of clay, which one heavy shower, such as the western inhabitants constantly experience, would completely level to the ground. The walls of the houses are formed of sun-baked clay, and are from eight to ten feet high. Upon these is supported a terrace roof, composed of branches of trees or bamboos, covered with clay. Nothing can be conceived more ugly than these villages. On every side square masses of dry clay, give one more the idea of huge ant-hills than of human habitations. In these places, wood being found in too small quantity to serve as fuel, cow-dung is used for this purpose; which being made into small cakes, is thus plastered on the walls of the houses to dry in the sun. When dry, it is collected into stacks, like peat-stacks in a Scotch village.

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* A native blanket.

† Borassus flabelliformis.

‡ Marshall, op. citat.

Darwar, which is situated on the eastern edge of the hilly tract, enjoys a tolerably cool and agreeable climate. The only time at which the heat is very oppressive is in March, April, and part of May; and even then a cool refreshing westerly breeze sets in every afternoon, and continues during the whole night. The luxury of this breeze is duly appreciated by those who come either from the interior, or from the eastern or western coast, where the nights, during the hot season, are close and oppresive, preventing sound sleep from refreshing the languid frame, overcome by the heat of the day. This cool breeze is felt but a very short way to the east of Darwar, for it soon becomes heated, by passing over the arid plains of that part of the country.

Speaking generally, it may be said, that, at Darwar, as in other parts of India, the wind blows during six months, viz. from the middle of April to the middle of October, from the south-west, and during the remaining months from the north-east. But it has been already mentioned, that, during the hot months, a cool wind blows all night from the west; and it must be added, that, for several weeks, at both equinoxes, the wind is variable.

Heavy thunder-showers fall at Darwar in April and May. The weather then continues cloudy; and the steady rain of the monsoon generally begins in June or the beginning of July. It is a curious circumstance, that the first heavy showers that fall do not come from the west, but are accompanied by the following phenomena. During the day the wind blows steadily from the south-west. Between three and five in the afternoon, black clouds are seen accumulating in the east. Cloud rises over cloud, until the whole eastern sky is covered with one dense black mass, which, now pierced every where by forked lightning, and accompanied by constant peals of thunder, slowly approaches against the western breeze. When it has approached very near, the wind suddenly changes, blows strongly from the east, and brings along with it heavy battering rain, and sometimes large hail. The wind changes frequently, blowing from all quarters of the compass, until at length it again becomes steady from the west, and the tempest ceases. This is repeated every day for some days, after which the wind continues to blow constantly from the west for five or six months. Storms also occur at the autumnal equinox, but not so regularly nor so violently as those just described.

Although there is a good deal of rainy weather at Darwar, yet there are seldom such deluges of rain as frequently occur on the coasts; and the total annual quantity of rain is certainly less than that which falls either on the western coast or on the Gauts.

It is a curious circumstance, that, while a cool breeze blows during the nights of the hot months in the southern Mahratta country, there is often at the same time a most perfect calm on the western coast; proving that this is not a sea-breeze, as supposed by many. It is probably owing to the peculiar surface of the country, and produced in the following manner. The Gauts and western parts of the country being covered with wood, and more plentifully supplied with moisture than the interior, must consequently be always cooler; but more especially at night, for the arid plains retain the heat of the day longer than the moist woods. The hot air of the interior, therefore, will ascend, and be replaced by the cool air from the western jungles, and thus give rise to a refreshing breeze, which will continue all night, and as long as it is not counteracted by the prevalent north-east wind, which, being always more powerful during the heat of the day, then gains the ascendancy. Now, as the western parts of the country are 2500 feet above the western coast, the wind which blows over them does not ascend from the coast below; for it has been already stated that the atmosphere on the coast continues calm: it must therefore be supplied from the same altitude; and we may accordingly conclude, that a mass of air above 2000 feet in height rests undisturbed on the coast, while that immediately above it, viz. on a level with the summit of the Gauts, is in rapid motion towards the interior.

The following remarkable and interesting appearances, which

I observed at Goa on the 6th of October last year, show, in a striking manner, what a great influence the Gauts have on the meteorological phenomena of this part of India, and also confirm the above observations regarding the western breezes of the southern Mahratta country. Large masses of clouds, with lightning and thunder, were observed on the Gauts about midday. The clouds gradually proceeded westward, but at a very great altitude; and, in the evening, they completely concealed the blue sky, stretching far to the west over the sea. The air below continued close and oppressive, and thunder was heard, high over our head, among the clouds that had proceeded from the Gauts. Thus the air, resting on the low country, continued undisturbed, while great hygrometric and electric changes occurred in the atmosphere, only on a level with the summit of the Gauts.

Fogs in the morning are very common at Darwar, and often present a very remarkable appearance. They invariably proceed from the west, and, about sun-rise, are seen rolling, in dense masses, over the hills. They sometimes appear black, at other times perfectly white, according to the spectator's situation in respect to the light. They are generally not very high, and vary much in their form and extent; sometimes covering a great tract of country, at other times being very partial, and stretching out, as it were, into long bands. When riding out in the morning, I have frequently observed a thick mass of fog on each side of me, while the intermediate space was clear; one of the masses having a black, the other a white colour, arising from their different situation in regard to the rising sun. These fogs never last longer than a few hours.

Having been ordered, by the Bombay government, to keep a register of the weather at Darwar, the following was commenced in January 1827. There ought also to have been a register of the barometer and hygrometer, but the former of these instruments was broken in its carriage to Darwar, and the latter could not be procured in India.

The thermometer was kept in a broad open virandah, at a distance from any wall, and, at the same time, completely in the shade. The spring-water, the temperature of which was taken, was from a well about sixty feet deep.

In the following table the mean of two observations, made at 10 A. M. and 10 P. M., is given, as probably affording a very near approximation to the true mean of the twenty-four hours. In order to ascertain how far this rule held good at Darwar, I observed the thermometer every two hours, day and night, during two successive days in February and two in March 1827, and found that the mean of all these observations was within $\frac{5}{100}$ths of a degree of the two observations made at 10 A. M. and 10 P. M.

It will be seen by the following table, that the mean temperature of the first ten months of 1827 was 75.212, and of spring-water 75.635. This will probably be a little too high for the mean of the whole year; for November and December are among the coolest of the twelve months; 75 therefore is, perhaps, a very near approximation to the true mean temperature of Darwar. The total quantity of rain which fell, from the commencement of the rains in April up to November, was $26\frac{1}{10}$ inches. The rain which fell in January, was quite unusual, and, indeed, such a circumstance was not remembered by the oldest inhabitant to have ever happened before. A few showers sometimes fall in November and December, but never any heavy rains. The supply of rain at Darwar, in 1827, was considerably less than usual.

Belgaum, which is the military head quarters of the division, has a much cooler climate, and a much larger supply of rain than Darwar, owing to its vicinity to the Gauts.

The mean temperature of Darwar is probably about ten degrees below that of Madras.

DARWAR—North Latitude 16° 28′; East Longitude 75° 11′. Height above the level of the sea 2400 feet.

1827.	TEMPERATURE.		RAIN.		GENERAL REMARKS.
	Air.	*Spring Water.*	*Inch.*	*Cents.*	
January	70.16	74.12			A good deal of rain fell between the 13th and 15th, which was a circumstance quite unprecedented in this month *. It was general over the peninsula; and occurred on the same day at Madras, here, and at Bombay. The rest of the month was generally clear. Wind E. and N.E.
February	74.71	74.12			The weather was generally clear, with dew during the night. Wind generally E. and N.E.; and, from the 15th to the 30th, westerly winds during the night.
March	77.22	74.70			Generally clear; with occasional fogs in the morning. Wind in the beginning of the month S.E.; in the end of the month rather changeable. Westerly winds during the night throughout the whole month.
April	80.42	76.41	1	30	Weather changeable. Occasional thunder and lightning. Wind changeable: the prevailing wind S.W.
May	80.27	77.49	1	38	Generally cloudy. Occasional showers, with thunder and lightning. Wind W.
June	74.78	76.95	9	49	Cloudy. Rain. A little lightning on the 2d, 3d, and 9th. Wind S.W.
July	72.90	76.15	6	20	Rather cloudy. Showers. Wind S.W.
August	72.65	76.28	2	39	Rather cloudy. Showers. Wind S.W.
September	72.88	76.34	2	88	Cloudy. Occasional showers. Wind S.W.
October	76.13	74.78	2	52	Generally cloudy. Occasional showers; and sometimes fog in the morning. Wind changeable.
Means	75.21	75.63			
Total quantity of rain	}		26	16	

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* The actual quantity of rain which fell in January could not be ascertained; for I had not then received the hyetometer.

(To be continued.)

On the Regions of Perpetual Snow in Norway and Sweden.
By Lieutenant-Colonel HAGELSTAM.

Height of the perpetual snow region, or line of congelation, reckoned in feet from the level of the sea. Latitude where the principal trees, plants, and cultivated vegetables cease generally to grow.

I. *Norway.*

THE snow region at the North Cape is 2400 feet. Cloudberries (*Rubus Chamæmorus*) on the summit of the Stappen Rocks, and islands adjacent. The dwarf birch at Hammerfest, Lat. 70° 40′ 5″. From recent experiments made at the instance of the Horticultural Society of London, the following vegetables succeed, viz. cabbages, turnips, carrots, spinage, lettuces. From the two latter a second crop. English peas produce in favourable summers.

From 70° to 69°.—Juniper bushes at Alten, near Lat. 70° The Scotch fir attains 60 feet and upwards. The snow region is here 3600 feet. Blaeberries (*Vaccinium myrtillus*). Barley succeeds sometimes in the valleys. Currants. Strawberries. Raspberries. Arctic raspberry (*Rubus arcticus*).

From 69° to 68°.—North of Lat. 67° no other natural wood is found in Norway than the birch and Scotch fir, and these only along the deeper fiords and considerable streams. The extraordinarily productive fishery of stor, torsk or cabeljo (stockfish *Gadus callarias* and *G. morhua*) takes place in February in the Vestfiord.

From 68° to 67°.—Whales and herrings abundant along the whole of the coast of Nordland. The inhabitants are entirely dependent on the fishery for their support. The snow region over the coast is 3300 feet; upon mountains 3900.

From 67° to 66°.—General limits of the spruce-fir. Rye ceases.

From 66° to 65°.—Oysters. Ash. Hemp. Spring rye succeeds more frequently than autumn rye, and in these latitudes ripens in from six to seven weeks. Cole cabbage.

From 65° to 64°.—Oats. Flax. Peas. Beans. Hops. Wheat in small quantity.

From 64° to 63°.—Gooseberries. The snow region to the west of the mountain range (Fjällrygg) is 4800 feet. Maple. Apple-trees. Cherry and plum trees in the valleys near the coast.

From 63° to 62°.—Pear-trees. Hazle. The oak found wild only along the coast, and most between Holmestrand and Mandal. It is planted as high as Drontheim, although very thinly. The snow region is 5300 feet above the Dovrefield. The walnut is planted, though it does not produce any fruit. Elm and linden.

From 62° to 61°.—The snow region upon the Langfield is 5410 feet. Asparagus. Between the Latitude of 58½° and 62°, the surface of the principal mountain chain is nearly altogether flat.

From 61° to 60°.—At 61° the snow region upon the Fillefield is 5600. The perpetual glacier upon the Sneebræn and the Folgefonden has now increased downwards to 1000 feet above the level of the sea in several places.

From 60° to 59°.—The snow region upon the mountain chain is 5800 feet; upon the Folgefonden it is 5000 feet. A waterfall of 946 feet perpendicular has been lately discovered, by Professor Esmark, in a valley in Bradsbergs Amt; it is called Haukenfossen. Beech wood is found only in the country between Laurvig and Tonsberg.

From 59° to 58°.—Wild rein-deer upon the chain of mountains. The constant temperature of the earth along the Norway coast is, at Vadsöe, in East Finmark, 34° 7′; at Altengaard, in Finmark, 35° $\frac{6}{70}$; about Drontheim, 40°; at Lyster, in the northern part of Bergen's Amt, 42° 8′; at Laurvig, about 45° 5′; at Christiana, about 44° 6′; (at Paris it is 53° 3′).

The above observations were made before 1810. In the centre of the Scandinavian peninsula, and on each side of the alpine ridge, in round numbers 500 perpendicular feet above the level of the ocean, cause as great a change and decrease in the climate and vegetation, as from 120 to 150 miles horizontal distance towards the north; 1000 feet in perpendicular height, equal from 26 to 325 miles; and 2000 perpendicular feet, about 585 miles. To the northward of Drontheim, up to Lat. 67° N. 500 feet in perpendicular height are equal only to from 120 to 130 miles, and 1000 perpendicular feet from 225 to 260 miles, in horizontal distance northwards. In the same proportion as the snow line sinks, or the temperature decreases more suddenly further north, the distance between climates near the sea, and those in height, *i. e.* on the mountains, becomes still more trifling, until at last the climates of both nearly meet at the North Cape. Although the principal part of vegetation diminishes, as above stated, according to the altitude, or in horizontal distance towards the north, a great variety of plants are nevertheless found in Lapland, and along the alpine chain, which do not grow in the lowlands of Norway and Sweden.

II. *Sweden.*

At the North Cape, neither the ocean nor quicksilver ever freeze. The greatest degree of cold during the winter there is from + 14° to + 10° 4′, seldom + 6° 8′, and commonly only + 21° to + 23°. The average temperature of the air throughout the year is, however, nearly 30°, or two degrees below the freezing point. At Upsala it is 42°; at Christiana 43° 2′; at Paris 52° 4′. The sun at the North Cape is never visible from the middle of November until the end of January; but, on the other hand, it never sinks below the horizon, or is out of sight, from the middle of May to the end of July.

The snow region at the North Cape is 2400 feet. At Lat. 70°, the shooting forth of the leaves takes place six or seven weeks later than at Upsala, and three weeks later than at Tornea. The small dwarf birch, mountain willows, small aspen, bird-cherry, and mountain-ash, as also the dwarf grey alder, are found only in the valleys and sheltered situations.

From 70° to 69°.—Turnips and potatoes. General limits of the birch-woods. General limits of the pine-woods. Barley reaches almost to the boundaries of the pine-woods, that is early barley.

From 69° to 68.—Bears in abundance. The general boundaries of the spruce fir to the north and east of the mountain chain. Currants. Reindeer, wild and tame.

From 68° to 67°.—Turnip cabbages. Cattle the principal means of subsistence. Horse-radish.

From 67° to 66°.—At 67° the snow region 4400 feet. North of this latitude the sun is visible the whole night at the time of the summer solstice.

(North Polar Circle.) Rye ceases to recompense the labour bestowed, on account of the frost. Carrots and parsnips.

From 66° to 65°.—Hemp does not ripen to seed every year. Garden peas. Corn grows, and ripens in from six to seven weeks.

From 65° to 64°.—At 65° the snow region is 4800 feet. The medium of the summer heat at Uleaborg has been observed to be twice as great as at the North Cape. Gardens of fruit-trees; they do not, however, succeed. Gooseberries. Oats to the north of this very seldom ripen.

From 64° to 63°.—Cabbages cease to come to a head. Flax does not ripen to seed to the north of this. The snow region is here 5200 feet. Peas, vetches, and beans; north of this they are found in inconsiderable quantity, and do not ripen every year.

From 63° to 62°.—Cherries. Alder (*Alnus glutinosa*). Maple. Wheat succeeds as far as Angermanland, but does not ripen in West Bothnia. Tobacco. Apple and pear trees can be planted with success as far as Sandswall. Ash and willow.

From 62° to 61°.—Hops. Vines in the hot-house. Hazle.

From 61° to 60°.—At 61° the snow region is 5800 feet. Elm and linden. The oak is planted as far as Sundswall. Asparagus in hot-beds. The plum bears as far as Gefle.

From 60° to 59°.—Buckwheat on dry heaths: it abounds in Scania. Pumpkins and melons in hot-beds. Apricots and peach-trees in the hot-house.

From 59° to 58°.—At 59° the snow region is about 6000 feet. The walnut and mulberry ripen in Gothland (when planted), the first even upon Kinnekulle in Scaraborg's Government upon chalky ground. Beech woods cease. This tree grows wild nevertheless, but in inconsiderable quantities north of Lat. 57°.

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The supposed recent Origin of America refuted.

A very ingenious naturalist, Mr Smith Barton, has said, with much justice, "I can only consider as puerile, and in no way proved by natural evidence, the supposition that a great part of America has emerged from the bosom of the waters at a later period than the other continents *." May I be permitted to quote a passage from a memoir which I composed, on the Native Tribes of America †. "Justly celebrated writers have often repeated, that America is, in every sense of the word, a New Continent. That richness of vegetation, that mass of immense rivers, those great volcanoes, always in action, announce, say they, that the earth, incessantly trembling and not entirely dry, is less removed from the original chaotic state than in the old world. Long before my voyage, such ideas appeared to me as unphilosophical as opposed to the generally known laws of physics. These images of youth and disorder, as well as of dryness and progressive loss of vigour in the Earth, as it grows old, could only originate with those who amuse themselves with seeking out contrasts between the two hemispheres, and do not comprehend under a general view the constitution of our planet. Will it be said that the southern part of Italy is a newer country than Lombardy, because it is almost continually shaken by earthquakes and volcanic eruptions? Besides, our present volcanoes and earthquakes are slight phenomena compared with those revolutions of nature which the geologist must suppose to have taken place in the days of the melting and cooling of the masses which have formed the mountains, when the Earth was yet in a state of chaos. Different causes must make the effects of the energy of nature vary in different climates. In the New World, the volcanoes, to the number of fifty-four, may perhaps have burnt longer, because the chain of lofty mountains in which they are situated is nearer the sea, and because this circumstance, and the perpetual snow which covers them, appear to modify the subterranean fire, in a manner as yet little appreciated. Earthquakes and eruptions act there periodically. At present physical disorder and political tranquility reign in the New Continent, while in the Old, the discords of the nations drive men to seek for rest in the bosom of nature. Perhaps a time will come when one part of the world will take the place of the other in this singular contrast between physical and moral energy. Volcanoes rest for ages, before they are again lighted up. The opinion that, in the older regions, there ought to reign a certain peace in nature, is founded merely upon a play of our imagination. One side of our planet can never be older than the other. The islands produced by volcanoes, such as the Azores, or gradually formed by mollusca, like many islands of the Pacific Ocean, are in general more recent than the granite masses of the central chain of Europe. A country of small extent, like Bohemia, and several valleys of the moon, circularly inclosed by mountains, may long remain covered with water, in consequence of partial inundations, and form a lake. After the waters have been entirely drained off, the name of newly-formed land might by metaphor be given to this, where vegetation would establish itself by degrees. But an aquatic envelope, such as the geologist figures to himself at the period of the formation of the secondary mountains, can only be supposed, consistently with the laws of hydrostatics, as existing at once in all parts of the world, and in all climates. The sea could not remain on the vast plains of the Oronocco and Amazon, without, at the same time, ravaging the countries situated around the Baltic. The concatenation and identity of the secondary strata near Carracas, in Thuringia, and in Lower Egypt, prove, as I have shewn in my Geological Picture of South America, that this great operation of nature has been performed at the same period over the whole earth.—*Humboldt, Tableau de la Nature*, tom. i. p. 133-139.

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* Fragments of the Natural History of Pennsylvania, vol. i. p. 4.

† Berliner Monatschrift, t. xv. p. 190.

Account of a Deposite of Fossil Plants, discovered in the Coal Formation of the Third Secondary Limestone, near Scarborough. With a Plate. By PETER MURRAY, M.D. Communicated by the Author *.

AN interesting geological discovery has lately been made near Scarborough, in Yorkshire, in Gristhorpe Bay, of a large deposite of fossil plants of the coal formation, presenting many varieties hitherto undescribed.

They occur in the strata called Coaly Grit by Mr William Smith, a pseudo coal-field below the corn-brash, but far above the coal measures of any moment, being superior even to the Oxford clay, marl-stone and lias. The thin seams of coal which accompany these plants are the highest in this vicinity, overtopping the Bath or inferior oolite; which again is above the other veins of bad coal which rise over the lias beds to the north, and contain similar vegetable remains, along with a singular arundinaceous stem, called by Mr Merchison Oncylogonatum carbonarium.

The Gristhorpe petrifactions appear in a fissile indurated clay, passing into a soft grit, and occasionally alternating with clay iron-stone, which is replete with nodules, intersected with veins of calcareous spar, and generally in the centre containing some vegetable impressions, for the most part varying from those in the clay; and, on account of the hardness of the stone itself, of greater sharpness and preservation. The plants lie layer above layer horizontally, and those of the same species (with some exceptions) occurring together, as if the localities of each had been extremely limited, and apparently as they had been swept down by a great and sudden torrent of water, many being laid, the one crossing the other; or bent partly underneath one branch, and then thrown over another, and some of the leaflets, as it were, squeezed together: Some very small and young; others large; others again even in fructification; and several of the specimens of considerable magnitude and beauty, and in admirable preservation.

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* The secondary limestones at present known are the following: 1. First or Magnesian Limestone; 2. Second or Shell Limestone; 3. Third, including Lias, Oolite, &c.; 4. Fourth or Chalk.—EDIT.

The plants are principally ferns, and are decidedly different from those of our other coal-fields; and most nearly resembling the specimens from Bornholm in the Baltic, but congeneric with many now existing in tropical regions.

Additional species are detected almost daily; and those already distinguished must exceed fifty. This prodigious variety of fossil filices, compared with those now vegetating in our climate, must strike the most casual observer. Here, in one narrow spot, not exceeding two or three acres in extent, we have already found fifty species; and, in a similar, but somewhat lower formation, within ten miles distance, at Cloughton, several other kinds, totally distinct, offering a number exceeding that of those now living in the whole island of Great Britain. So that these northern regions must, in those early ages, have presented as numerous and diversified a display of ferns, many most specious and luxuriant, as the wilds of Southern Africa now do of the heaths; although we must not presume to compare the dark unvarying hue of fern clad wastes, with the splendour and endless tints of the heathy plains of the Cape.

The interesting deposite at Gristhorpe Bay may be considered as a vast herbarium, of which the leaves opening to the readiest observation, offer every facility and pleasure in the examination; and not, as is the case with the generality of coal plants, surrounded with dirt, and darkness, and perils, imbedded in the roofs and sides of mines; and they resemble so many fine drawings in Indian ink, or the shadows of delicate foliage by moonlight cast upon a smooth and white ground or wall.

The vegetable nature of these curious impressions is remarkably shewn by the scarcely fossilized state of one of the varieties, apparently a fern allied to the genus Isoëtes, which, when detached from the imbedding stony mass, still retains elasticity and flexibility, and burns like a piece of charred wood. Others yet preserve, even in their clay bed, much of their original colour, a dull red resembling that of some fuci; and portions of such leaflets may be peeled away,—are perfectly flexible and combustible,—and are actually semi-transparent and striated, and afford most pleasing and curious objects for a microscope. They are, however, so completely carbonized, as not to yield either tannin or resinous matter, in the experiments which I have instituted.

Several of these ferns apparently range under well known genera; and one especially is characterized as a polypodium, by its lines of round seeds along the back of the leaf, parallel to the central vein or mid rib; and another, as an equisetum, by the spike of cryptogamous flowers, and verticillate leaves.

Others, again, deficient in fructification, can only be guessed at by the general habit; and of such, we seem to detect examples of the genera of Asplenium, Scolopendrium, Isoetes, and more abundantly of the Polypodium, comprising the Aspidium, Cyathea and true Polypodium. The fact is, the genera of ferns are sufficiently obscure and difficult to arrange, even in a recent state; but, when fossilized, nearly impossible satisfactorily so to do, as species in a state of fructification are rarely to be met with, and even then the involucre, upon which so much depends, is, and must be, indistinguishable. Some specimens appear of species now unknown in Europe; and of those, many appear to be varieties of the tree ferns, which constitute such numerous and splendid ornaments of tropical forests. And there can be little doubt but some of the luxuriant fronds, belonging to this class, when detached from the parent stem, and found thus petrified, may greatly mislead an observer; and, by being regarded as separate plants, needlessly multiply the number of species. These arborescent filices must have been very abundant, as numberless stems, of considerable magnitude, are to be seen interspersed with the other small plants; sometimes indeed so compressed, as to present nothing but a mere impression; but, occasionally, retaining a stalky rotundity, of which the interior is converted into the enclosing stony matter, while the cortical part is completely carbonized.

In the superior strata, which constitute these pseudo coal deposites, we observe, with only a few scattered exceptions, the remains of the softer or herbaceous vegetables, as the Cycadeæ, Filices and Gramineæ; while, at greater depths, we find a dense consolidated mass of vegetable matter in the true coal-fields: From what cause can such *undeviating difference* arise? Can, indeed, the latter be the trunks,—the timber of the primæval forest overwhelmed under that enormous pressure; and the former, the surrounding herbaceous plants, principally growing in loose and marshy ground along the outskirts of these woods?

That difference of structure in the same vegetable may be followed by difference in petrifaction, even under similar circumstances, we have innumerable instances. The common lepidodendrons of every coal measure are completely changed, as to the main trunk, into sandstone; while the cortical envelope is only carbonized. The soft succulent interior is wholly gone, and its place supplied by the stony matter of the investing strata; but the firmer harder bark still exhibits traces of its origin, sufficiently distinct to designate the natural order, if not even the very genus.

In the immediate vicinity of these fossil plants, much interruption, and consequent ambiguity, takes place in the regular arrangement of the strata, by frequent and extensive slides or slips of the rocky beds; so that, to any casual observer, the higher line seems occasionally to lie beneath one, in reality, far its inferior in order; and this especially happens, whenever a slide of the gravelly diluvium has descended, so as also to cover the intermediate deposites. And, in similar instances, where any resemblance exists between the upper and lower strata, the confusion will be yet greater, and will demand no little strictness of investigation.

Even stratifications similar in relative position, and in probable antiquity, and undisturbed in their situations, vary so very much in colour, structure, and chemical composition, as to defy all classification by any sensible qualities; while their precise position is oftentimes so perplexed and obscured, as to render the difficulty not removeable by that resource.

But here it is, that the vast excellency and usefulness are shewn of the plan laid down by M. Brongniart, in France, and Mr William Smith, in England, who shew that similar fossils characterise similar formations, and thus give us the means of determining the nature and place of any strata. By noting the contained petrifactions, an observer may thus readily pronounce whether a mass, however displaced, belong to the highest oolite or the lowest, or to the undecomposed marlstone. Another instance in point may be cited in the green sand, so frequently, if we may be allowed so to speak, of all colours but green, and varying also exceedingly in structure, yet is well and decidedly marked by its numerous and beautiful fossil shells.

It is one of the many advantages of geological knowledge, that, in similar circumstances, both disappointment and loss may be avoided by attending to the situation of the strata in which certain minerals, coal for example, make their appearance. Tens of thousands of pounds have been hopelessly wasted in the vain expectation of finding coal in the coaly grit, and the deluded adventurer lured on to ruin by the *ignis fatuus* of these insignificant carbonaceous seams accompanied by fossil vegetable remains, resembling, in many respects, those which actually overspread the true coal-field.

Many of the futile attempts in mining will be done away by the diffusion of sound geological principles, since an acquaintance with the strata will afford a tolerably correct notion as to what ores, if indeed any, lie underneath.

Even in arts evidently less closely allied, as in that of planting, will the science of geology be useful. The subsoil is often of far more importance to the growth of particular classes of trees than the mere soil; and this can only be learned by an accurate knowledge of the nature and bearings of the rocky strata.

Had geology conferred no other benefit upon society than this, of guiding the miner in the true and right path to his subterranean treasures, and warning the enthusiastic speculator from pursuing a fleeting shadow, it would have been entitled to a place among those sciences which demand the attention and respect of mankind. But of a far higher character is the strong confirming light which it reflects upon the historical records of Holy Writ, which tell of a sudden and universal flow of waters overwhelming the whole surface of the earth.

Geology demonstrates, by many irrefragable marks, every where to be seen, that a mighty inundation has actually passed over all lands, apparently from north to south, at no very remote period, and covering the more solid beds of rock with a varied deposition of clay and sand, intermingled with rounded pieces of stone detached from masses at vast distances, and of a very different nature from any in the immediate vicinity.

In the diluvial deposits, for instance, of the coast of Yorkshire, may be found the granites of Cumberland and Scotland, particularly that of Shap Fell; the botryoidal magnesian limestone of Sunderland; metalliferous limestone, with galena, compact prehnite, and even the serpentine of Banffshire; and occasionally bones of extinct quadrupeds, as the tusks and molares of the fossil elephant; while rounded nodules of agate, mocha stone, and jasper, also abound in the same gravelly beds, broken up by the tides and wintry storms.

But in viewing such diluvial coverings of ancient date and extensive range, we must be careful not to confound with them, local and far later depositions, the effects of partial and generally of fresh water inundations. The bursting of a lake, the change in the course of a river, or the transitory passage of some wintry torrent, leave a wreck behind them of gravel, mud, and fragments of stony masses swept from distant hills, which may locally cover the strata for a short distance, and contain bones and shells far more recent than those occurring in that universally diffused gravel every where to be met with.

As in all sciences, so in geology, it is hard to say whether more harm, more hinderance, have arisen from too great a spirit of generalisation, or from views too partial and narrow. Thus in the "Theory of the Earth," the first writers, led away by the fascination of the subject, built up their cobweb reveries, their gilded dreams, upon a few isolated and doubtful facts. More recent geologists have perhaps erred on the other hand; and, dreading the ridicule and reproach attached to their precursors, have amassed numerous and valuable materials, without an attempt to compare or to combine. The survey and observation of one district, or even of one kingdom, will never suffice; the united and judicious comparison of many and distant countries can alone lead to any thing like a grand, comprehensive, and accurate map of the rocky structure of the earth. Particular links in the great series of strata may be lost or observed in one country; but this must be rectified by attentive surveys of the order of position in another, and by what shades one formation passes into another.

When such enlarged views, such connected investigations of the rocky bases of different countries shall have been made, we may not still indeed possess a full and incontrovertible system of all the changes which this planet has undergone, but we shall have more precise and philosophical terms, whereby to denominate the strata and deposites originating from these changes; and we shall, with tolerable certainty, be enabled to pronounce as to their relative age. Neither shall we any longer be perplexed and obstructed by the local or harsh sounding names, as of Jura Limestone or Coral Rag, of Kimmeridge Clay or Cornbrash, of Kelloway Rock or of Crag, names confined to one single district, or to a few naturalists, without regard to one uniform consistent nomenclature.

EXPLANATION OF PLATE V.

Fig. 1. A Fern, displaying a most curious and singular diversity of form in the same leaf. In the genera Acrostichum and Onoclea, the fertile fronds contract around the fructifications, and give to one leaf a very different form from another: and the same thing is seen in the Blechnum spicant, which indeed bears much resemblance to our coal-plant in general habit, but which varies in this biform leaf, tongued at the extremity, and pinnated towards the base.

2. A Polypodium, characterised by its capsules disposed dorsally, in round spots, parallel to the midrib. Drawn one-third of original size.

3. A very beautiful and delicate fern, occasionally met with in fructification, so nearly obliterated as hardly to allow of its classification. Probably an Aspidium.

4. Drawn about a fourth of the natural size, and presenting a plant nearly allied, by its terminal spike of cryptogamous flowers, to the genus Equisetum.

On the connection between the Phases of the Moon and Rainy Days. By M. Flaugergues.

There exists between the phases of the moon and the rainy days which coincide with these phases a constant relation, which would appear very singular, did not what we have observed of the thermometer afford an explanation of it. From the calculation which I have made of the rainy days that have coincided with the days of the moon's phases, and with those of the perigee and apogee, during the period of nineteen years (from the

19th October 1808 to the 18th October 1827), I have found the following numbers of days.

	PHASES OF THE MOON.					
	New Moon.	First Quarter.	Full Moon.	Last Quarter.	Moon in Perigee.	Moon in Apogee.
Number of Rainy Days coincident with the Days of the Moon's Phasis,	77	82	79	69	93	78

It is seen by this table, that the numbers of rainy days which coincide with the days of the moon's phases, and of the perigee and apogee, follow the same progress as the mean heights of the barometer corresponding to these phases, but in the inverse ratio. Thus the number of days of new moon on which it rained is less than the number of days of full moon on which it rained; and the mean height of the barometer, the day of the moon's conjunction, is, on the contrary, greater than on the day of her opposition. In like manner, the number of rainy days that agreed with the first quarter, much exceeds the number of rainy days that coincided with the last quarter, and the mean height of the barometer is much less in the first quarter than in the last quarter. Lastly, the number of rainy days that have coincided with the days on which the moon was perigee, is much greater than the number of rainy days that corresponded with the days on which she was apogee; and, on the contrary, the mean height of the barometer when the moon is perigee, is much less than the mean height of that instrument when the moon is apogee.

All this is perfectly explained, by the constant observation, which has long been made, that it rains more frequently when it is high. Thus, the superiority of the number of rainy days corresponding to the full moon, in the first quarter and perigee, over the number of rainy days that coincide with the new moon, the last quarter and the apogee, arises from the circumstance that the barometer is lower and the pressure of the atmosphere less in these three first lunar periods, than in the three last. Thus, all that can be concluded from our remark is, that the diminution of the atmospheric pressure, caused by the moon's attraction, must be reckoned among the causes that determine the fall of rain.

4

A Tour to the South of France and the Pyrenees, in the year 1825. By G. A. Walker Arnott, Esq. M.W.S. (Continued from a former Number).

But it may be interesting to the botanist to have a more particular account of these plants; and in attempting to do so, I shall follow as nearly as possible the route.

Near the entrance of the valley is situated the village of Eynes, about an hour's walk from the Cabanasse; and soon after passing it, we observed by the side of the path the beautiful *Eryngium Bourgati:* the season was, however, scarcely enough advanced for it. At the mouth of the valley, the meadows were covered with *Nigritella angustifolia* and *Phalangium liliastrum.* This last, so often confounded in the herbaria with *Ph. liliago,* is extremely distinct in the live state, the stamina being declinate and curved, as in *Hemerocaulis,* a circumstance which has induced De Candolle to place it in that genus; but the perianth is divided to the base, which has induced Andryjosky to make of it the new genus *Czackia.* Few will, however, agree to this: indeed, I do not see how it can be placed in a different genus from *Phalangium* (*Anthericum* of Sprengel, whose genus *Bulbino* contains the true *Antherica,* among which are *A. planifolium* and *serotinum*). Having entered the valley, we passed through a small wood, and ere long procured *Vicia pyrenaica,* Pourr. (*V. Fagonii,* Lapeyr.), *Lychnis alpina, Didymodon glaucescens,* and a few others; but we afterwards regretted our delay there, as all these were much more abundant higher up the valley. Leaving the wood, we found among some rocks a few specimens of *Pedicularis comosa,* a beautiful species, with fasciculated roots and yellow flowers. From this to the Jasse de Delmau (a shepherd's hut in ruins), we kept alongside of the stream, and observed *Carduus carlinoides* and *Saxifraga adscendens,* (*S. aquatica,* Lap.) in the water; and on the rocks several other species of *Saxifraga,* among which were no doubt *S. muscoides, moschata, exarata, pubescens, intertexta, mixta,* and several others of authors, but between which here, there were so many hybrids or intermediate states, that we found it impossible on the spot to group them into species. Opposite to the Jasse on the banks of the stream, was the splendid *Gentiana pyrenaica*, covering a considerable space with its deep blue blossoms. This plant was to me of extreme interest, as I had received a communication upon it from my friend M. Guillemin of Paris, a few days before I had left Montpellier. "The structure of the fruit," says he, "is very remarkable: it is truly club-shaped (*claviformis*); that is to say, the ovary is upon a long pedicel, and the capsule, tolerably short and round, splits and forms two reflected lobes at the summit of the pedicel. This structure also exists in *G. aquatica* from Caucasus, and in *G. sedifolia* from the Andes of Peru. M. Kunth, in his splendid work, figures the latter, but is singularly mistaken in regarding the reflected valves of the capsule as monstrous stigmas." Though we saw so much of this species in flower, and were able to see that the ovary was pedicellated, we could not procure one plant with mature fruit.

Farther up the bank, but still opposite to the Jasse de Delmau, were *Ononis rotundifolia*, Linn. (Spec. Pl. ed. 1. not ed. 2. which De Candolle has named *O. tribracteata*, and is perhaps either a monstrosity or an imaginary plant), *Luzula lutea*, *Saxifraga media*, *Veronica aphylla*, and thousands of *Adonis pyrenaica*. On this plant much discussion has taken place between De Candolle and Lapeyrouse; the latter insisting on its being the true *A. apenina*, L., while the former declares that the plant of Linnæus is a variety of *A. vernalis*, and that the *A. pyrenaica* is not found in the Apennines. But lately Professor Moricaud (Dec. Pl. Ital. 6. p. 5. No. 58.) has actually met with a plant on Monte Velino, which he calls *A. apenina*; this is also the *A. pyrenaica* of Brocchi (Cent. 1823), and scarcely differs from the plant of the Pyrenees: in both, the radical leaves are on long petioles; but in the Italian plant the petiole is not trifid, but simple, and is dilated at the base into a sheath. In it, the petals are from 12 to 16, obovate and entire, and the carpels are scabrous, not smooth, as in *A. pyrenaica*. I believe the Italian plant to be that of Linnæus.

Following the course of the river, *Phaca astragalina*, *Oxytropis montana*, and *Hutchinsia alpina*, were every where abundant. *Papaver pyrenaicum* was also met with, but sparingly. The valley began now to contract, and we crossed the stream (we had hitherto kept it on our left). *Dicranum latifolium* (*Didymodon apiculatum*, nob.), was of common occurrence; but what we valued more, were a few specimens of *Potentilla prostrata*, Lap. (a mere dwarf state, however, of *P. fruticosa*), and of a cruciferous plant that we had little hesitation in thinking might be *Thlaspi heterophyllum*, DC. Although the fruit was not sufficiently advanced to allow us to examine the structure of the seeds, we referred it to the genus *Lepidium*: it is indeed an intermediate species between *L. campestre* and *L. hirtum* *. Here, too, we met with *Draba aizoides*, Linn. (not *Dr. brachystemon*, DC. which alone is cultivated in Britain as *Dr. aizoides* †), *Dr. nivalis* and *Dr. lævipes*, DC. which, though perhaps a variety, we at first sight distinguished from *Dr. stellata*, that also occurred here.

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* It is *L. heterophyllum*, Benth. Cat. What we here found had the leaves glabrous. Mr Bentham even states that the silicules are glabrous: they are certainly free from hairiness, but there exists on them very minute scales, much smaller than those that occur in *L. campestre*; the style is filiform and elongated, as in *L. hirtum*. From *L. hirtum*, Linn. such as is found at Montpellier, having the silicules free from scales, and very pilose, it is surely very distinct; but I fear it is identical with *L. hirtum* of Smith, and (as far as I have seen specimens) of all British botanists. Under *Thlaspi hirtum*, Eng. Bot. t. 1803, Sir James says, " This species differs from *T. campestre*, t. 1385. in having a perennial woody root, more oblong and less tumid pouches, whose sides are *often very hairy*, and, when destitute of hairs, are but obscurely dotted, never so scaly as in that species. But for a new and decisive character, I am obliged to Mr Leathes, who justly observes, that the elongated style projecting far beyond the lobes of the pouch, will always distinguish this species from the *campestre*, whose short style is just equal to those lobes." With the exception of the words above in Italics, which refer to the Montpellier plant, the whole of this applies most admirably to our *L. heterophyllum*. The *L. hirtum* of Smith, however, has always, I believe, the leaves more or less hairy, while that from the Vallée d'Eynes is quite glabrous. I am not, however, inclined to think that a sufficient mark of difference, as we afterwards met with the same plant in the Vallée d'Andorre with the leaves glabrous, but the stem pilose, and at Mont Louis specimens agreeing with those of England in every respect.

† This is also *Dr. aizoides*, Don, Hort. Brit. No. 186., and which Smith (Eng. Flora, iii. p. 156.) says is the same with that found in Wales. One specimen, indeed, I possess from M. Winch, and supposed to be native, is certainly identical with that cultivated, and seems to show that Wales is the *patria* of our garden plant; but unfortunately specimens in Dr Hooker's rich herbarium prove that the Welsh and continental ones are the same.

The river now soon forked, and we ascended the mountain between the branches. Here the vegetation was scanty, but entirely alpine. *Ranunculus parnassifolius*, *Gallium Villarsii*, Req. and *Iberis carnosa*, were in every debris till we reached the summit. Here the mist and rain came on us so thick, that we could scarcely see twenty feet before us, and consequently could have no view, or have any idea how the road was to turn. We, however, took the more prudent plan, and tracked the mule that carried our luggage, and which, with our guide, had gone on long before us. After a long and winding descent, in which we only procured *Aretia carnea*, *Lychnis alpina*, *Ranunculus parnassifolius*, *Azalea procumbens*, *Festuca eskia*, and *varia*; *Schœnodorus spadiceus*, *Trichodium alpinum*, and some others, most of which we had already gathered, we arrived at the river in the valley, and, crossing it, soon came in sight of our resting-place.

As we botanized the following day in the valley of Querals, we again saw profusion of *Gentiana pyrenaica*; we also fell in with a few large tufts or cushions of *Galium pyrenaicum*. *Daphne collina*, *Nigritella angustifolia*, *Pedicularis foliosa*, and *Ranunculus aconitifolius* were observed; and on a rock between the Hermitage and the head of the valley, we got *Lecanora chrysoleuca α*, Ach. (with which *L. liparia β*, Ach. is identical), and *Androsace imbricata*, DC. Much confusion has of late arisen regarding this species, and in their elaborate Systema, Rœmer and Schultes seem to have increased it; but the characters proposed by De Candolle are alone entitled to any regard; those given by Lapeyrouse, and adopted by Sprengel, do not appear to exist at all. At all events, the *A. argentea*, Gært. and Lapeyr. is the *A. imbricata*, DC. and what we found at Nouri: it is covered with a close, white, starry pubescence. Of it I possess Swiss specimens, under various erroneous names, as Aretia helvetica, tomentosa, pubescens, &c. The *A. bryoides*, DC. has the leaves, especially towards their point, furnished with simple, diaphanous, reflexed hairs, which are apparently glutinous. This, of which I have never seen a Pyrenean specimen, may be *A. aretia*, Lapeyr., though I confess I suspect with De Candolle, that Lapeyrouse's plant is only a state of

A. imbricata. As to the true *A. bryoides*, Rœmer and Schultes seem to have it in view in their description of *A. helvetica*.

Lapeyrouse says that *Sarcocapnos enneaphylla* grows on the walls of Nôtre Dame de Nouri: we saw no such plant. *Rumex pyrenaicus* also indicated here, is merely *R. acetosella*.

On the 26th, as I have already mentioned, we re-ascended the Cucillade, and followed our old track pretty closely till we got to the Jasse de Delmau, keeping the river on our left: we then ascended a ravine to our right, which in fact constituted a part of the mountain of Cambredazes; and here we soon found *Daphne collina*, and *Alyssum** *diffusum*, DC. How far this last really differs from *A. montanum*, I cannot point out: it is certainly, to use a favourite phrase among such modern botanists as seem afraid of uniting too much, "*nimis affinis*." We again met with *Androsace imbricata* upon the rocks, as well as *Primula viscosa*, *Androsace villosa*, and *Pedicularis comosa*. Returning to the Cabanasse by the village of Eynes, we found in a meadow *Angelica pyrenæa*, Spr. (*Seseli pyrenæum*, L.), and *Phleum commutatum*.

These, with a few others, as *Salix retusa*, *S. pyrenaica* (with which *S. ovata*, Ser. is identical), *Biscutella lucida*, *Trifolium cæspitosum*, *Pedicularis rostrata*, *Potentilla Halleri*, Ser., *Artemisia mutellina*, *Ornithogalum luteum*, and *Pyrethrum alpinum*, of each of which we only procured at most one or two specimens, and whose precise localities I do not remember, formed the most interesting part of our three days' herborization.

With the exception of a walk round Mont Louis, to search for *Nepeta latifolia* and *violacea* (which, however, we did not see), we were principally engaged till the 30th in drying our plants. That day, however, we resolved to ascend the mountain of Cambredazes.

This mountain, at least what fronted us, is in the shape of a horse shoe, with an immense valley in the centre, towards which, on all sides, but particularly at the farther end, the rocks were very precipitous. We left the Cabanasse about four in the morning, and, passing St Pierre, we kept to the right, in order to examine that side of the great valley. A dense fog, however, came on, so that, had we not studied well our course yesterday from the windows of the inn, it is not probable we should have attained our object; and after, indeed, we did arrive in the valley, we found the rocks so very shelving and rugged, that for some time we gave up all thoughts of attempting the summit. We here sought with great attention for *Globularia nudicaulis*, which we did find, and *Gl. punctata*, Lap. indicated here, but of which we saw no traces. Indeed, we were inclined to suspect, from no botanist having since met with it, that it might be either a variety of, or a hybrid between, *Gl. cordifolia* and *vulgaris* *. At the head of the valley we saw *Adonis pyrenaica*, *Dryas octopetala*, and *Saxifraga ajugæfolia*: *Silene ciliata*, *Veronica bellidifolia*, and *Cerastium glaberrimum*, Lap. (probably a variety of *C. alpinum*), were occasionally also observed. About this time the weather cleared up a little, and we again formed the resolution of scrambling to the top, which we finally accomplished, not without difficulty and danger. We were, however, repaid by finding on the summit of the ridge *Saxifraga retusa* in abundance. This is generally esteemed a plant of rarity, nor has this station been given for it: it can never surely be mistaken for *S. oppositifolia*, though at first sight may be overlooked for *Azalea procumbens*, so glossy and compact are its leaves. Passing the summit, and descending a little on the other side, we saw as much as we could desire of *Androsace vitaliana*, a plant whose name is not derived from the Latin word *vitalis*, but, as Lapeyrouse remarks, from Vitaliano Donati, in honour of whom Sesler had constituted it into a genus. We got nothing worth recording in our descent, although we changed our course.

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* I intended here to have made a few remarks on Mr Brown's paper on *Alyssum*, published in the Appendix to Denham and Clapperton's Narrative, which I for the first time saw in Glasgow, at Dr Hooker's. I took no notes of it, trusting to see it in Edinburgh; but I now find no copy has as yet reached this quarter.

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* M. Lapeyrouse says that he himself found it here. If that were the case, it is strange that in his own herbarium, which we had afterwards an opportunity of examining at Thoulouse, there is but one miserable specimen, without even the radical leaves, and without any locality. Lapeyrouse says that he had since seen it in the herbarium of Vaillant, with the denomination "*Bellis alpina minima Origani folio*, Tourn." a plant which is universally allowed to be *Gl. incanescens*, Viv. I see no reason why this plant may not be found in the warmer parts of the Pyrenees, as well as in Tuscany; but I cannot help suspecting that Lapeyrouse's specimen came from Vaillant's herbarium, and not from the mountain of Cambredazes. His long description evidently belongs to *Gl. incanescens*, and must have been taken from better specimens than he himself was possessed of. I think it also not improbable, that, in looking over Vaillant's herbarium, he conceived that he recognized a plant he had formerly seen at Cambredazes, but not gathered (supposing it at the time, what I still believe it to be, a variety of *Gl. cordifolia*), and from this the whole error may have arisen.

(To be continued.)

Discovery of a Fossil Walrus or Sea-Horse, in Virginia; of the Fossil Skull of an extinct species of Bos (Ox), from the Banks of the Mississippi; and of Fossil Bones, identical with those of the Megatherium of Paraguay, in Georgia, United States.

I. *Discovery of a Fossil Walrus or Sea-Horse, in Virginia.*

IN the Annals of the Lyceum of Natural History of New York (No. 9. November 1827), there is a Report by Messrs Mitchill, J. A. Smith, and Cooper, on a portion of a fossil skull sent to Dr Mitchill, by Mr Cropper, of Accomac County, Virginia. They found it to be the anterior part of the cranium of a species of walrus. It comprises the entire sockets of the two great tusks, the palatine and maxillary bones, with the sockets of eight molar teeth; and the bony isthmus, which, in this animal, connects the tusks, remains, though much mutilated. Four of the molares are also left, and one other has but recently dropped out. From the appearance of the three remaining sockets, the teeth must have been lost out of them at a very distant period; and probably during the life of the animal. The tusk is remarkably hard and heavy, and no sutures are visible, except between the palatal bones. The tusks have become almost agatised, and their fracture is conchoidal, presenting a very smooth surface, and a flinty colour and consistence. The fragment bears the greatest resemblance to the analogous part of the existing species, *Trichecus rosmarus*. Dr Mitchill hopes yet to succeed in obtaining an exact description of the locality where it was discovered. It bears marks of having been in salt water, and is said to have been found on the sea-beach, where it has probably been washed out of its bed by the waves. That it is fossil, and not recent, the authors have no doubt. The change which the substance of the teeth has undergone, and the appearance which the whole bears, of having long lain buried in the earth, are sufficient proofs of this. Moreover, the country in the vicinity whence it was sent, is known to belong to a marine formation; and ribs, and other parts of a vertebrated animal, have been dug up there, which were supposed to be those of a species of Lamantin or Manatus, an animal related to the walrus. Fossil bones of this genus are exceedingly rare. Cuvier mentions only a few molar teeth and pieces of bone disinterred in France. The existing species inhabits the northern parts of the Atlantic and Pacific Oceans. Whether or not the fossil head in question is to be referred to this species, the authors are unable to decide with certainty; but they are more inclined to consider it as belonging to another species now extinct.

II. *On a Fossil Ox from the Mississippi.* By Mr J. E. Dekay.

In an interesting paper by Mr J. E. Dekay, in the Annals of the Lyceum of Natural History of New York, November 1827, on a fragment of a fossil skull of the genus Bos, from the banks of the Mississippi, he shews that it, in all probability, is part of an extinct species, and the same as that found by Pallas in Siberia. He concludes his memoir, which we regret our limits will not allow us to give at full length at present, with the following inferences:

"That there formerly existed within the actual limits of the United States, four, and probably five, species of the genus Bos. Of these, only one is at the present day found in our country in a living state. The *Bos americanus*, or bison, formerly existing in great numbers in the states bordering on the Atlantic, is now driven to the boundless regions of the west, and ere long will probably share the fate of the former companions of his race.

The second and third species (*B. bombifrons*, and *B. latifrons*) have long since ceased to exist. Their specific differences are not yet completely ascertained; but the animals seem to have been numerous, if one may judge from the accounts of travellers, who speak of their remains as occurring in great abundance. From the fact of their having been found associated with remains of the mastodon and deer, it is presumed that they were co-existent with those species.

The fourth species is the *Bos moschatus*. From the testimony of travellers already cited, it has been shewn that this species formerly lived in the latitude of 40°, and even lower. It is now confined within the limits of the Arctic Circle. They live in herds, feed on lichens, leaves of the willow, and are fond of mountainous rocky regions. The horns of the male, which are larger than those of the female, sometimes weigh sixty pounds. This species has been recently separated by Blainville, from the genus Bos, and forms the new genus *Ovibos*; a division which does not seem to be generally adopted by subsequent naturalists.

Under the name of *Bos Pallasii*, we would propose to designate the species to which we refer the fossil crania of Pallas and Ozeretskovsky, and provisionally, the specimen from the banks of the Mississippi, which has given rise to the preceding remarks.

This animal was, as far as we know, an inhabitant of the extreme northern regions of Europe and America. In the latter country, its remains have been found as low as 37° north, as the locality of our specimen indicates. It was, doubtless, allied in many particulars to the musk-ox; but from this, the observations of Cuvier, and the imperfect notices contained in the preceding remarks, shew the great probability of its being specifically distinct.

III. *On the identity of the Fossil Bones found in Georgia, United States, with those of the Megatherium of Paraguay.*

Mr Cooper, in a paper read to the Lyceum of Natural History of New York, January 1827, informs us, that, since a former communication on the subject of the Fossil Bones of Skidaway Island, he had obtained, through the kindness of Dr Habersham, several other parts of the skeleton of the megatherium. The collection last received consisted of numerous pieces, nearly all fragments of the large bones of the extremities. They had all marine shells adhering to them on the fractured surfaces, as well as the others. Of these fragments, the author confines his remarks to a few, whose peculiar conformation renders them of the greatest utility for comparison with the descriptions and figures of Cuvier and others. The first bone which he notices, is the united tibia and fibula. It was broken into three pieces, which, when brought together, formed nearly the entire bone. On comparing it with the minute description of bone, and with the figures recently published by Pander and D'Alten, the resemblance was found to be nearly perfect. This bone belonged to the left side. The following are its principal dimensions:

	Inches.
From the anterior border of the upper extremity to the anterior border of the lower,	24.1
From the posterior border of the upper extremity to the posterior point of the lower,	25.6
Breadth at its widest part, including the fibula,	12.5
Breadth at its narrowest part, just below the foramen,	10.4

These dimensions, he observes, agree sufficiently with those which Cuvier assigns to the corresponding bone of the megatherium. The other portion, which he particularly notices, is one of the metacarpal-bones, and quite perfect. On comparing it with the bones of the megalonyx, of which there are good casts in the Lyceum, he was immediately struck with its great resemblance to that which Cuvier considers as the metacarpal-bone of the middle-toe of the left fore-foot; and a further examination satisfied him, that it was in fact the corresponding bone. Cuvier speaks of the enormous size of the metacarpal-bones of the megalonyx; but, enormous as they are, this of the megatherium is at least ten times as large. In other respects there is a great general resemblance, though the bone from Georgia is shorter in proportion to its thickness and height; and, from the appearance of the vertical ridge at the lower extremity, could not have admitted of as much motion as the articulation with the first phalanx. There is also in this ridge a pretty deep notch, which is not found in the megalonyx. The author concludes with stating, that a gentleman of Savannah is said to have in his possession, from the same island, an entire lower maxillary-bone, agreeing in all respects with the description of the megatherium, which, he remarks, must have belonged to a different individual from that whose remains are now in the cabinet of the Lyceum; thus shewing, that parts of at least two different skeletons of this animal have been discovered in the United States.

On the Luminousness of the Ocean.

THE luminousness of the ocean is one of the most beautiful phenomena of nature, which excites surprise, although, for months together, it may be seen every night. The sea is phosphorescent in all latitudes; but he who has not witnessed this phenomenon in the torrid zone, and especially in the Pacific Ocean, can form but an imperfect idea of the magnificence of such a spectacle. When a vessel of war, impelled by a fresh breeze, cleaves the foamy waves, and one is stationed near the shrouds, he cannot be satisfied with viewing the beautiful phenomenon which presents itself. Every time that the side of the ship, as she rolls, emerges from the water, flashes of reddish light seem to issue from the keel, and dart toward the surface of the sea. Le Gentil [*] and the elder Forster [†], explained the appearance of these flashes by the electrical friction of the water against the body of the advancing ship. But in the present state of our knowledge, this explanation is no longer admissible.

There are few points of natural history respecting which there have been so many disputes as the light emitted by the waters of the ocean. What we know with precision on the subject, reduces itself to the following facts. There are various shining mollusca which, during their life, emit at pleasure a rather weak phosphoric light, generally of a bluish colour. This is observed in the *Nereis noctiluca*, the *Medusa pelagica*, var. β [‡], and the *Monophora noctiluca*, discovered during Captain Baudin's expedition [||]. Of this number are also the microscopic animals, which have not as yet been determined, and which Forster saw swimming in the sea in innumerable multitudes, near the Cape of Good Hope. The luminousness of sea water is sometimes occasioned by these living lanterns. I say sometimes; for, in most cases, notwithstanding the use of magnifying glasses, no animal is perceived in luminous water; and yet, whenever the wave happens to strike a hard body and breaks, producing foam, and whenever the water is strongly agitated, a light is produced resembling a flash of lightning. This phenomenon probably originates from the decomposed fibrils of dead mollusca which exist in infinite quantity in the depths of the sea. When this luminous water is passed through a piece of dense cloth, these fibrils are sometimes detached from it under the form of luminous points. When we bathed in the evening in the Gulf of Cariaco, near Cumana, some parts of our bodies remained luminous on coming out of the water. The luminous fibres stuck to the skin. From the immense quantity of mollusca dispersed through all the seas of the torrid zone, it need not be surprising that the water of the sea is luminous, even when no organic matter can be separated from it. The infinite division of all the dead bodies of dagyses * and medusæ may render the entire sea capable of being considered as a gelatinous fluid, and which is in consequence luminous, has a nauseous taste, cannot be drunk by man, but affords nourishment to many fishes. If a board be rubbed with a part of the body of the Medusa hysocella, the place rubbed becomes luminous whenever the finger, well dried, is passed over it. During my passage to South America, I sometimes put a medusa on a tin plate. If I struck the plate with another metal, the smallest vibrations of the tin were sufficient to make the animal shine. How did the blow and the vibration act in this case? Was the temperature instantaneously raised? Were new surfaces uncovered, or did the blow make the phosphuretted hydrogen gas escape, so that, coming into contact with the oxygen of the atmosphere, or with the water of the sea, it produced combustion? This effect of the blow which excites the light is particularly striking in a jumbling sea, when the waves dash against each other in all directions. Between the tropics, I have seen the sea luminous at all temperatures; but it was more so before storms, or when the sky was

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[*] Voyage aux Indes, t. i. p. 685–698.

[†] Observations made during a voyage round the world, 1683, p. 57. In German.

[‡] Forskoe, Fauna Ægyptiaco-Arabica, p. 109.

[||] Bory St Vincent, Voyage aux Iles d'Afrique, t. i. p. 107, pl. 6.

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* The genus Dagysa belongs to the Salpa tribe of Cuvier.

lowering, cloudy, and much overcast. Cold and heat seem to have little influence upon this phenomenon; for, on the Bank of Newfoundland, the phosphorescence is often very strong at the severest time of the winter. Sometimes, all other circumstances appearing to be the same, the phosphorescence is very distinct on one night, and the following night there is scarcely any. Does the atmosphere favour this disengagement of light, this combustion of phosphuretted hydrogen? Or do not these differences depend merely upon chance, which leads the navigator into a sea more or less filled with mollusca? Perhaps, also, the luminous animals only come to the surface of the sea when the atmosphere is in a certain state. M. Bory St. Vincent, asks with reason, why our fresh marsh-water, which is filled with polypi, is not luminous? It would appear in fact, that a particular mixture of organic particles is necessary to favour this disengagement of light. Willow-wood is more phosphorescent than oak. In England, salt-water has been rendered luminous by casting herring brine into it. Galvanic experiments shew that the luminous state of living animals depends upon an irritation of the nerves. I have seen an *Elater noctilucus*, which died, diffuse a strong glow when I touched its anterior extremities with tin or silver. Sometimes, also, the medusæ give out a stronger light at the moment when the galvanic chain is closed. *Humboldt, Tableaux de la Nature*, tom. ii. p. 80–87.

Observations on the Structure of Feathers and Hair.

I. *Observations on the Structure and Development of Feathers;* by Fred. Cuvier. (Mem. du Museum d'Hist. Nat. t. xiii. p. 327.)—*Inquiries into the Structure and Development of the Prickles of the Porcupine, followed by Observations on Hair in general, and on its Zoological Characters;* by the same. (Read to the Academie des Sciences, Oct. 1827.)

In the first of these Essays M. F. Cuvier explained the structure and development of feathers; and imagined that he had discovered differences between their development and that of hairs, which had been considered as analogous; but in the second he has compared and united the modes of formation of these organs, to which he was led by new observations, different from any previously made on the subject.

The differences which the author establishes in his first memoir between hairs and feathers, were founded on the circumstance, that hairs are produced by the exhalation of the matter which is secreted by the nervous papillæ, which serve successively as a mould to each of their parts, while the formation of feathers was more complicated, according to his ideas, and the presence of a particular organ rendered necessary, which he named the *Producing Capsule (Capsule productrice.)* This capsule is the result of a spontaneous and transitory creation, analogous to that which gives rise to the horns of the stag, of whose future forms, or even existence, no indication is presented previous to their appearance. The producing capsule of the feathers is formed absolutely in the same manner on the dermic papilla, which indeed furnishes it with a base, and contributes to its development by the enlargement of its proper vessels; but, without the capsule having more connection with the papilla than any parts of organized bodies have which assumed their points of departure from those which have preceded them. A circumstance which has undoubtedly prevented naturalists hitherto from being acquainted with the producing organ of the feathers, is, that it continually varies, and that only a small portion of it can be observed at once. The part which has secreted the first portion of a feather is obliterated, in fact, the moment this portion is formed, and the part which is to follow makes its appearance. This, again, which will produce the second portion, is obliterated in its turn, as soon as it has answered its purpose; and this process continues until the feather is completed. It is therefore seen, that the producing capsule, could the parts of which it is successively formed be united, would necessarily equal the feather itself in length. If we now reflect that there are birds in which the feathers are renewed every year, in a few days, as it were, and that, of these feathers, there are some which have a length of several feet, an idea will be formed of the importance which at this period the twofold formation of the capsule and feather acquires; and hence the most satisfactory explanation of the accidents which in birds accompany the casting and development of the feathers at the period of moulting.

M. Frederick Cuvier, in his second memoir, has commenced his inquiries respecting the development of hairs with the quills of the porcupine, which are, in reality, nothing but long hairs, but whose structure is more apparent, and their producing organ more easily examined.

He here establishes a perfect analogy between prickles and feathers. Both are produced by the same organs, and are subjected to the same mode of growth. In the prickles, as in feathers, the horny matter is produced by the membrane of a sheath, and the spongy matter by the surface of a bulb; and it is exclusively from the form of these same organs that the form of the prickles result, which, like the feathers, are produced in a real mould.

Hairs do not, as was hitherto supposed, form an essential part of the skin. They have a principle of existence of their own, and belong to a system of organs not less remarkable, sometimes, for its complexity than for its development. This system may be associated with the dermis, and be developed in different points of its substance; but even then, it is not confounded with that organ, but preserves its peculiar nature.

M. Cuvier concludes from this, that the hair has never hitherto occupied the rank which is due to it in zoological systems.

He considers the organic system which produces the hairs as analogous to that of the senses, and even as forming part of it; for in a great number of animals the hairs are a very delicate organ of touch. The slightest touch, even that produced by a hair of the human head, is sufficient to make certain animals, cats for example, contract their skin and make it tremble, as they always do to rid it of light bodies which stick to it, and of whose presence they are apprised by this peculiar sense of touch.

M. Cuvier concludes his interesting memoir with explaining a disease, the nature of which has hitherto been involved in the greatest obscurity. We mean the *Plica.* The two singular and distinct affections which are designated by this name, consist, the one, of an excessive development of the hair; the other, of a bloody matter which flows from it when it is cut, it being also even alleged to possess sensibility. A greater activity in the generative organ of the hairs is sufficient to produce the first of these symptoms; and a diseased state of the bulb of the central part, which produces the spongy matter of the hair, and which grows as well as it, sufficiently accounts for the second.

II. *Observations on the Epidermis, the Sebaceous follicles, and their augmentation in Cancerous Tumours, and on the Human Hair;* by Professor Weber of Leipzig. (*Archiv. sur die Physiologie,* 1827.)

Although the memoir refers, in a great measure to Dr Eichhorn's work on the skin, it contains, besides, much curious information. M. Weber first remarks, that the infundibuliform fossæ on the prominent lines of the palm of the hand, were described and figured as being the pores of the sweat, by the celebrated Grew, in the Philosophical Transactions for 1684, p. 566. M. Eichhorn cannot, therefore, claim to himself the merit of their first discovery.

On raising horizontally from the palm of the hand, with a sharp razor, a layer of epidermis, more or less thick, we find the inner surface of this layer, not smooth, but traversed by furrows and elevated lines, resembling those of the outer surface, and corresponding exactly to them, so that a prominent line at the outer surface answers to a furrow on the inner, and *vice versa;* while to the infundibuliform pits of the outer surface there correspond internally, small rounded oval or convex prominences, arranged in rows along the furrows. As the same thing is observed, whatever may be the thickness of the layer of epidermis raised, the author concludes that the epidermis is composed of an assemblage of thin layers, superimposed upon each other, and agglutinated together,—a structure which many anatomists have already admitted as the most probable.

Passing to the examination of the *Sebaceous follicles,* the author maintains, contrary to Dr Eichhorn's opinion, that these follicles form organs distinct from the bulbs of the hairs, and that they exist in the whole extent of the skin, with the exception of the palms and soles. The bulbs of large hairs have their seat in the deepest layer of the dermis, and penetrate as far as the subcutaneous adipose tissue. The sebaceous follicles, on the contrary, are placed nearer the surface of the skin, and are never found in the adipose layer; nor can they be confounded with the bulbs of the hairs, their size being much larger than theirs. Lastly, the structure of these organs is very different. In newly born children, the sebaceous follicles may be discovered on all parts of the body, excepting the two mentioned. They are particularly large in the skin of the scrotum. Each of these follicles is composed of four or five compartments, or cellules, agglomerated together. Their transverse diameter is greater than that which extends from the bottom of the excretory orifice. The greatest transverse diameter observed by the author was three-fourths of a line.

The great development which the sebaceous follicles assume in the parts of the skin which are affected with cancer or fungus, also furnishes a proof of their existing over the whole extent of the skin.

In microscopical researches respecting the structure of hairs, it is of advantage to make use of a single lens, with a very small focus (from one-fourth of a line to a line), in place of the compound microscope, which often gives rise to error, in making mere inequalities existing at the surface of the skin to be confounded with internal cellules. The transverse section of the hairs should also be carefully examined. For this purpose, the hair is placed on a piece of smooth paper, on which several parallel lines cut each other at right angles. The hair is fixed by its two extremities with wax, and is cut with a very sharp razor, placed in the direction of one of the lines which fall perpendicularly on the hair, and with the edge directed vertically toward the paper. Thus prepared, the hair presents its transverse section in a very distinct manner. From inquiries made in this manner, the author concludes, that the human hair has neither a canal in its interior, nor a cellular structure; an opinion already given out by Rudolphi, but contradicted by M. Hensinger. It is otherwise with the hairs of the roe, they presenting, in whatever manner they are examined, hexagonal cells, whose diameter is placed transversely. But this hair differs from that of man in many other properties. There are no cellules in the woolly hair of the sheep.

The form of the human hair is rarely cylindrical. It appears to be so only in the straight hairs. In the curled hairs, the section is elliptical or oval. The flattened form appears to be necessary to the curling of the hairs, and the cylindrical figure seems to form an obstacle to it. In Negroes, the hairs present a very marked flattening. In the wool of the sheep, which appears to be cylindrical, another cause probably gives rise to the phenomenon of curling; namely, the transverse inequalities with which the surface of the hairs is furrowed.

The author gives four tables of micrometrical measurements of the hairs of the white man and Negro. In the numerous observations which he made, he sometimes found these parts ulcerated, as it were, at their surface, like carious teeth. The hairs of the back of the hand frequently break at some distance from their point. This rupture appears to be a normal phenomenon, which nature employs to prevent these hairs from becoming elongated beyond measure. At the place of rupture, there are observed small interlaced fibrils, which for some time retain, in contact, the two ends placed together at a right angle, until their detached extremity at length falls.

The author has also made some experiments on the elasticity of the human hair. It may be elongated about a third of its length. The contraction which follows is somewhat less; the hair of the roe has scarcely any extensibility, and breaks with the greatest ease. It has more analogy to the feather of a bird than to human hair.

On the Level of the Sea.

IT is well known that the ocean retains the same level in the deep basins of the sea, and that its vast surface preserves a permanent form all around the globe. If it be raised by tempests it is reduced by equilibrium within the limits which are assigned to it. If the earth, as Pouillet remarks *, were immoveable, and formed of homogeneous strata, the surface of the sea would be strictly spherical. The navigators who pass under the line, those who traverse unknown seas in either hemisphere, and those who visit the coasts of Greenland, or the seas still nearer the pole, would all be at the same distance from the earth's centre. This would be the state of things in consequence of the laws of hydrostatics, and the structure of the solid parts of the globe, which presents trifling inequalities at the surface. Great inequalities in the solid parts would disturb the sphericity of the liquid surfaces. Were the chain of the Cordilleras only a hundred times higher, the waters would rise on the coasts of America, on the eastern as well as the western side; and would occupy a lower level on the opposite coasts, leaving the ports of France dry, as well as those of Japan.

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* Pouillet's *Elemens de Physique*, t. i. p. 137.

If the earth were stationary, and formed externally of heterogeneous parts of very unequal density; if, for example, under the Atlantic Ocean, between the crust which forms its bottom, and the centre of the earth, there should occur vast cavities, empty or filled with substances of small density, it is evident that the intensity of the attraction of gravitation would be much less on the waters of the Atlantic, than those of the other seas, and that then the general surface of the waters, instead of being everywhere spherical, would be raised in some parts, and depressed in others. Thus, a heterogeneousness of substances might of itself produce irregularities of form, and if to this cause there be added the influence of the centrifugal force, it will be seen that the question becomes still more complicated. In our present state of ignorance respecting the internal structure of the globe, into which, with all our power, we are only able to penetrate to a very trifling depth, the only means which we have of finding the true form of the surface of the seas, are geodesical operations, and observations with the pendulum. By the first of these means we arrive at a knowledge of the fact, independently of all hypothesis and of all explanation; and by the other we shall perhaps be able to discover some general laws of the internal structure of the earth, or at least some of the local causes that may alter the regularity of its surface. The equilibrium of the waters depends upon the direction of gravity, and the oscillations of the pendulum depend upon the intensity of the same force. It is difficult to discover *a priori* in what degree these two elements are connected together, and to what extent they may be determined by each other; and it is this that gives still more importance to the inquiries whose object is to determine them with accuracy.

Almost all the basins of the sea communicate in various ways, whether by wide canals, or by more or less contracted straits; and the waters in these different basins are subjected to the conditions of equilibrium of communicating vessels. Only it must be observed that the water of the sea is not a homogeneous liquid in the whole extent of the mass: the temperature changes with the latitude; and it also changes with the depth; the degree of saltness changes in like manner; and all these causes make the density to vary in the different places, and from this there results a multitude of motions, by which the equilibrium tends to be kept up. The water of the Atlantic flows into the Mediterranean by the Straits of Gibraltar, as is proved by the rapid current existing there; but it is not known whether, by an opposite current existing at a greater depth, the water of the Mediterranean may not pass into the ocean. If this second current exists, they are both without doubt produced by the difference of density in the layers of water. If it does not exist, it must be supposed that the Mediterranean loses by evaporation, or by other causes, more water than it receives by the Nile, the Rhone, the Danube, and all the rivers that empty themselves into it, and that the Atlantic Ocean makes up the loss, in order to keep it at the height required for equilibrium.

The following are the results that have hitherto been obtained respecting the level of the seas. During the French Expedition to Egypt, a commission of engineers, under the direction of M. Le Pere, determined the relative heights of the Red Sea, and Mediterranean. This operation is worthy of great confidence; and, for result, it gives a very remarkable difference of level between these two seas, which are so near each other at the Isthmus of Suez, and which, besides, communicate with the Ocean. At low water the Red Sea is 8 metres 12″ above the Mediterranean, and at high water its excess of height rises to 9 metres 9″. Thus is confirmed the opinion of the ancients respecting the danger of opening up a communication between the two seas. At the present day, a great part of Egypt would be submersed by the Red Sea; and yet the bed of the Nile and the soil of Egypt are constantly raised by the deposit of mud which every succeeding inundation leaves. M. Girard has made very curious inquiries into this subject. By taking the present height of the floods, at the Nilometers of Elephantina, and of the Island of Rondah, and comparing it with what it formerly was, he found the measure of the elevation of the ground, which he estimates at 126 millimetres in the century. Considering it as such, it would still require many centuries to bring Lower Egypt merely to the level of the Red Sea *.

In the course of the operations for measuring the meridian in France, M. Delambre calculated the height of Rodez above the level of the Mediterranean Sea at Barcelona, and its height above the ocean, which washes the foot of the tower of Dunkirk. These two heights are equal to a fraction of a metre; whence it follows that if there does exist some difference of level between the Mediterranean Sea at Barcelona, and the Atlantic Ocean at Dunkirk, the difference is at least very small.

M. de Humboldt, in his journey in America, made barometrical observations on the shores of the Atlantic Ocean, and on those of the South Sea, from which some knowledge may be derived respecting the relative height of these two seas. From barometrical means taken on the one hand at Carthagena, Cumana, and Vera Cruz, on the east coast of Mexico, and on the other hand, at Callao and Acapulco, on the shores of the South Sea, it would result that the South Sea is about seven metres higher than the Atlantic. Other observations made by M. Humboldt would give a somewhat greater difference; but that celebrated traveller gives the above results only as a first approximation, supposing that the unequal heights of the tides, the different hours in harbours, and the greater or less extent of the horary variations of the barometer, are so many causes which may have an influence upon such delicate measurements.

The level of the Caspian Sea has been the object of several recent inquiries. It was determined in 1818, by MM. d'Englehardt and Parrot, in their curious journey to Caucasus and in the Crimea; by M. Pansner, in 1816; and about the same time by M. Wisniewski, who published, in the *Petersburg Memoirs*, the series of observations which he made with the same object in 1812. All these measurements agree in placing the level of the Caspian Sea much beneath the level of the Black Sea. According to the mean result, this difference may be estimated at 100 metres, or about 325 feet. Yet along the shores of the Caspian Sea, and to a great distance from its present banks, there are striking proofs to be seen of the abode of salt water. The nature of the ground, its form and chemical composition, the remains of shells, and the skeletons of fishes, with which it is filled, seem to leave no doubt remaining, that the sea formerly covered all these steppes to a distance of several hundred leagues. How has the depression of level which is now observed been produced? What is become of the mass of water which is wanting, and which may be estimated as a volume of 30,000 square leagues of surface by a metre of height? These are problems, the solution of which it will take a long time to effect; for they are connected with general geology, and perhaps with the great catastrophes of which Caucasus has been the theatre.

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* In a former number of this Journal, there is an interesting view of the French observations on the comparative level of the Red Sea, and the Mediterranean Sea.

The mixture of the water of rivers with that of the sea, also presents some hydrostatical phenomena, which it is curious enough to observe. Fresh water being lighter, ought to keep at the surface, while the salt water, from its weight, should form the deepest strata. This, in fact, is what Mr Stevenson observed in 1818, in the harbour of Aberdeen, at the mouth of the Dee, and also in the Thames near London and Woolwich. By taking up water from different depths, with an instrument invented for the purpose, Mr Stevenson found that, at a certain distance from the mouth, the water is fresh in the whole depth, even during the flow of the tide, but that a little nearer the sea, fresh water is found at the surface, while the lower strata consists of sea water. According to his observations, it is between London and Woolwich, that the saltness of the bottom begins to be perceptible. Thus, below Woolwich, the Thames, in place of flowing upon a solid bottom really flows upon the liquid bottom formed by the water of the sea, with which it is no doubt more or less mixed. Mr Stevenson, however, is of opinion, that, at the flow of the tide, the fresh water is raised, as it were, in a single mass, by the salt water which flows in, and which ascends the bed of the river, while the fresh water continues to flow toward the sea.

These experiments tend to confirm the opinion given out by Franklin on this subject, in 1761. "If some rivers," says he, "empty themselves into lakes, without the latter ever overflowing their banks, it is because the water is then spread out under so large a surface, that there is daily removed by evaporation a mass of liquid about equal to that which flows in. But there are rivers which, from the extent of their course, and the breadth of their mouth, may be compared to lakes. To complete the resemblance, it would only be necessary that a dike should stop the course of the water, and prevent it from being emptied into the sea. There would then occur some differences of level, according to the seasons; but in general, under certain circumstances, these differences would be confined within narrow limits. Although the communication between the river and the sea be open, it may be supposed that the dike of which we have been speaking, really exists in the surface of junction of the fresh water and salt water. Only this dike would be moveable; it would ascend a certain number of miles with the tide, and afterwards descend. The extent of the excursions would vary with the volume of the water. In some cases, we might also expect to find the sea water, and that of the river, mingled together on meeting, and this to a greater or less extent, from the twofold effect of their motions, and of the difference of their specific gravities; but at a certain distance from the mouth, the fresh water, first carried down by the current, and again thrown back by the tide, would oscillate nearly within the same limits, without even reaching the sea. An ignorant person would imagine that the water flowed off, and was partly lost through some crevices in the earth, while in reality it is by the air that it escapes.

On the Rocks that afford the Gold Dust or Gold Sand met with in Rivers.

AS gold-dust or sand is met with in several of the river-districts in Scotland, we think the following observations will interest those who may amuse themselves in search of gold in this country.

Mr Rengger some time ago gave an account of the auriferous sand of the Aar, the Emme, and the Ilsis, in Switzerland, which he had an opportunity of observing himself. It occurs diffused in the sand and gravel of the bottom of the valleys watered by these rivers. When the height of the water occasions the river to carry off part of its banks, the auriferous sand is deposited at the first place where the rapidity of the current finds an obstacle. The sand, after it has been deprived of the lighter parts, such as clay, calcareous earth, &c. consists of small grains or plates of gold, magnetic iron, zircon, garnet, spinelle, &c. The Aar, from its exit from the Lake of Thun to its arrival at Jura, flows only through sandstone mountains, as is also the case with the streams which it receives in its course. The Reuss and the Limmat have deposited the debris of the Alps in the bottom of a lake. The only exceptions are the Saune, the two Emmes, and the Sihl, which rise in the alpine limestone. The sandstone and coal deposits appear, therefore, to be the beds from whence the different parts of the auriferous sand have been carried into the basin of the Aar.

The author has analyzed varieties of sandstone from different countries, as from Stæffelbach, Mægenwyl, and Bollingen, and found magnetic iron in them. He presented to the meeting of Naturalists in Zurich grains of iron taken from pulverized sandstone from the latter place. If the proportion of the gold to the iron be taken as a scale, the former must occur in this standstone in so small quantity, that a trial made on the large scale alone could succeed in extracting it.

M. Roulein, however, some years ago, found gold in the sandy marl which belongs to this formation; and small scales of gold have been observed in the pebbles of nagelfluh quartz of the same formation. The constituent parts of the auriferous sand seem to have been brought together from sandstone mountains, and deposited by natural washing. This washing had undoubtedly commenced during the excavation of the valleys. The heavy parts of the broken-down matrix remained, the light parts were carried farther, and the parts of the auriferous sand, after traversing large tracks of ground, and after a long series of ages, were gradually compacted, until at last they appeared under the form of mud. The opinion generally entertained by gold-hunters is, that it is only in the ancient bottoms of valleys that auriferous sands occur, and that the recently submersed countries never furnish any.

From all that we have said, it follows that the sandstone formation is the immediate source of the auriferous sand of the Aar. Toward the Rhine, on the other hand, where gold-washing was formerly vigorous, especially near Coire and Mayenfeld, there are no traces of sandstone mountains, at least in this part of the basin of the Rhine. The gold must here have been immediately derived from its original site, the transition limestone mountains of the Alps. There is seen, among others, a place of this kind toward the eastern declivity of the Galanda, at the foot of which the Rhine flows, and where, at various periods, attempts were made to form establishments for the extraction of gold.

Essay on Comets, which gained the first of Dr Fellowes's Prizes, proposed to those who had attended the University of Edinburgh within the last Twelve Years. By David Milne, Esq. A. M. F. R. S. E. Edinburgh, 1828.

Dr Fellowes, in October 1826, proposed, for the encouragement of science, the following Prizes:—"The sum of L. 50, with a Gold Medal, for the best *Essay on Comets,* and L. 25 for the next best in merit; to be composed of those candidates who, within the last *twelve years,* have finished their philosophical studies in the University of Edinburgh."

Several Essays were sent in. These were examined by a Committee of the Senatus Academicus, who reported, in March 1828, as follows:

"Copy of a Minute of the Senatus Academicus of the University of Edinburgh, of date 4th March 1828.

"Professor Leslie laid before the Senatus Academicus a Report as to the Fellowes' Prize; of which the Senatus unanimously approved.

"The Report was as follows:—With the assistance of my learned colleague Professor Wallace, I have carefully examined the Essays on Comets received by me since the enlarged programme was issued, and find that the Discourse written by Mr David Milne is very far superior to the rest, and fully entitled to the first of Dr Fellowes' Prizes. We also find, that, though the other Essays evince ingenuity, and considerable extent of reading, yet we do not think ourselves warranted to bestow the Second Prize on any of them. We hope, therefore, that the Senatus Academicus will sanction this decision; and we farther propose that our body should testify their regard for so estimable an alumnus as Mr David Milne, by desiring him to print the Essay. Mr Milne has already obtained the honour of A. M.

(Signed) "JOHN LESLIE.
"WILLIAM WALLACE."

"Extracted from the Minutes of the Senatus Academicus by
"ANDREW DUNCAN, jun."

Having obtained a sight of Mr Milne's elegant memoir, (about to be published), which contains the most complete description and history of Comets in our language, we now lay before our readers its Table of Contents, and an Extract, with the view of enabling those interested in this very curious and important part of the natural history of the heavens, to judge of its extent and style of execution.

"CONTENTS.

PART I.—PHYSICAL CONSTITUTION OF COMETS.—1. Nucleus of Comets; 2. Envelope of Comets; 3. Tails of Comets; 4. Light of Comets; 5. Examples of these Phenomena; 6. Opinions respecting their Nature.

PART II.—MOVEMENTS OF COMETS.—1. Opinions relative thereto; 2. Orbits of Comets, Conic Sections; 3. Orbits most probably Elliptic; 4. Difficulty of finding the Elliptic Orbit; 5. Parabolic Method of Investigation; 6. Elliptic Method of Investigation.

PART III.—INFLUENCE OF COMETS AND PLANETS ON EACH OTHER.—1. Perturbations in their Motions, occasioned by proximity; 2. Physical Changes caused by Proximity; 3. Perturbations in their Motions occasioned by a Collision; 4. Physical Changes caused by a Collision; 5. Has such a Collision ever happened to the Earth? 6. Will it ever happen to the Earth.

PART. IV.—COMETS IN VARIOUS STAGES OF MATURITY.—1. Diminution of the Substance of Comets; 2. Herschel's Theory of Consolidation; 3. Are Comets habitable bodies.

PART V. — VIEWS RESPECTING THE SYSTEM IN GENERAL.—1. Theories respecting the Origin of Planets and Comets; 2. An Objection to La Place's theory removed; 3. Olber's theory as to the Extent of the Planetary System, erroneous; 4. The existence of an Ethereal Medium proved by Comets; 5. Comets indicate the universality of Gravitation; 6. Conclusion."

The extract is, Comets in various stages of Maturity.

" 1. From a careful examination of those Comets whose motions are exactly known, on their successive returns to the perihelion, much valuable information of a different nature may be obtained: For, if they happen to have undergone any change in their physical constitution, during the period of their absence, that change will probably be indicated by a corresponding variation in their appearance. Since the effect of the solar power is so great (whatever be the mode of its operation) in pushing away the nebulous matter of the Comet, into the form of a tail, it has been supposed that some of this nebulous matter may even be altogether detached from the attraction of the nucleus, so as to cause a gradual diminution in the Comet's substance; and this effect, it is obvious, will be the more easily produced, if the gravitation of the nebulous particles to the nucleus be weakened by a rotatory motion of the Comet. Now, an attentive examination of those Comets, whose approaches to the sun at the perihelion are near in respect of distance, and frequent in respect of time, may enable us to judge whether or not this supposition be well founded. But this is a point to which the attention of astronomers has been too recently directed, to be yet very satisfactorily fixed. Numerous data are requisite, which a constant and careful observation can alone supply, before any decisive result can be obtained. But certainly the observations of astronomers, as far as they have been made, with regard both to the diminished size of the nucleus of all comets after a perihelion passage, and the inferior brilliancy of Halley's in particular, at its last appearance *, seems to confirm what other considerations abundantly suggest, that a partial abstraction of nebulous matter does take place at every approximation of a comet to the sun.

" The question, therefore, very naturally occurs, whether a Comet, after a long succession of revolutions, will not be liable to become altogether annihilated by this dispersion of its nebulous matter? Herschel's opinion respecting the constitution and formation of comets, here deserves our attention, as it satisfactorily resolves the difficulty which is

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* Brande's Astron. ii. 68.

now proposed. There is no individual perhaps in the annals of astronomy who has contributed more to our knowledge of the heavens than Sir William Herschel, both by extending the limits of our vision into the most distant parts of the universe, and by investigating the laws which govern the more complicated phenomena of nature. But of all his contributions to the science, none are so important in themselves, or so well calculated to disclose to us the secret and marvellous operations going on in the workshop of Nature, as the discoveries which he has made concerning nebulæ. These nebulæ, it is supposed, are formed by the partial condensation of matter, probably the etherial medium itself diffused throughout the universe; and that their number must be prodigious, is sufficiently proved by the fact, that Herschel, by his own efforts alone, discovered 2000 of them. Some of the nebulæ are found to have so strong a resemblance to many comets, which, on account of their distance from the sun, can just be discerned from the earth, that they are not unfrequently confounded [*]; and it is only by a nearer approach, or by an intimate acquaintance with all the nebulæ in the same quarter of the heavens, that astronomers are able to distinguish them. Now, it is the opinion of Herschel, and his opinion is strongly supported by the authority of La Place [†], that Comets are originally minute nebulæ, which, by the continual approximation of their particles, have at length acquired such a degree of density, as to be capable of being attracted by the sun, and of describing an orbit of their own. As the nebulous mass approaches the sun, one result, as we have seen, is the expansion of its parts, and their prolongation into what has been termed the Tail: But, another result, according to Herschel, and one no less important, is a gradual consolidation of the nebulous matter by the agency of the solar heat. " It is admitted on all hands," says he, " that the act of " shining denotes a decomposition, in which at least light is given out; but that many other elastic volatile substances escape at the same time, especially in so high a degree of rarefaction, is far from improbable. Since light then, certainly, and very likely other subtile fluids also, escape in great abundance during a considerable time before and after a comet's nearest approach to the sun, I look," says Herschel, " upon a perihelion passage in some degree as an act of consolidation [‡]."

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[*] " By the gradual increase of the distance of our Comet," says Herschel, speaking of the Comet of 1807, " we have seen that it assumed the semblance of a nebula; and it is certain, that had I met with it in one of my sweeps of the zones of the heavens, as it appeared on either of the days between the 6th December and the 21st February, it would have been put down in the list I have given of nebulæ."

[†] Connoissance des Tems, 1816. [‡] Phil. Trans. 1812-14.

"II. This process of consolidation will evidently be the more powerful, the more that the Comet is subjected to the sun's calorific action; a condition which depends upon two circumstances; one, the perihelion distance of the Comet, the other, the time in which it completes its revolution. It follows from this consideration, that we may be able even to estimate the degree of solidity which Comets have attained, simply by taking into account these two circumstances; and a reference to observation will at once shew whether or not the theory be correct. But before attempting to apply this test, one remark must be made, which shews that the application of it may not in all cases be conclusive. If all Comets during their successive revolutions round the sun, were to remain totally exempt from the possibility of receiving any accession of foreign matter, tending to enlarge their bulk, then we might expect that the consideration of their perihelion distance and their period of revolution should always correspond with the amount of their solidity, or, in other words, the actual size of their nucleus. But if we suppose with Herschel, La Place, and other eminent astronomers, that there exist multitudes of nebulæ throughout space in every different stage of maturity, from those whose formation has just commenced, to those whose condensation by the attraction of the particles has already so far advanced, as will soon render them capable of gravitating towards the sun, we must reckon it not impossible that Comets, in the extensive range of their orbits, may occasionally meet with some of these nebulæ, and thus carry with them a new supply of unperihelioned matter in their next approach to the centre of the system. In this manner, the loss of substance to which, as we have above remarked, comets are exposed, by volatilization, may possibly be restored; while, in process of time, they may acquire a magnitude and solidity considerably surpassing what could have arisen from the primitive quantity of their nebulous matter. Certainly we are not at liberty to suppose, that this fortuitous junction of a comet with nebulæ takes place frequently; but, in estimating the consolidation of different Comets, in order to find whether the result corresponds with what the frequency and nearness of their approach to the sun would lead us to expect, we ought to recollect that the test is not infallible, from the possibility of an accession of nebulous matter having occurred in the manner we have now described.

"Herschel's theory, with respect to the agency of the solar heat, in promoting the consolidation of comets, necessarily implies, that the envelope and tail gradually become less extensive, and that the nucleus, upon whose surface the nebulous matter consolidates, gradually increases in magnitude. In these respects, therefore, some difference ought to be indicated by the physical appearance of those comets whose perihelion distances and periods of revolution are not the same; a condition confirmed by the examination of several, that have been the most attentively observed. The second Comet of 1811 had a nucleus, which, according to the continental astronomers, amounted to 570 miles *; while its tail was 500,000 miles in length. The Comet of 1807 possessed a nucleus of less size, but a tail of greater brilliancy; the diameter of the one being only 538 miles, the length of the other 9,000,000. The first Comet of 1811, which, from its splendid appearance, has been termed the great Comet of 1811, was observed to have a smaller nucleus; but, on the other hand, its envelope and tail were far more extensive: the diameter of its nucleus was 428 miles, and its tail stretched out no less than 132,000,000 of miles. The first of these three comets, then, according to Herschel's theory, must have been subjected in a much greater degree to the consolidating influence of the sun's heat than either of the other two, seeing that it had the largest nucleus, and the least quantity of nebulous matter: and the like result ought to be indicated with respect to all the three comets, on a comparison of their respective periods and perihelion distances. The periodical revolution of the great Comet of 1811 is found to be 3383 years, and it approaches 1.55 nearer the sun at its perihelion, than the other Comet of 1811: the product of these two numbers is 5243. The periodical revolution of the Comet of 1807 is 1713 years, and its perihelion distance is 2.46 times less than that of the second Comet of 1811: the product of these two numbers is 4213. The periodical revolution of the second Comet of 1811, whose perihelion distance we have taken equal to 1. as the standard of comparison, is 875 years. These numbers, then, 5243, 4213, 875, representing inversely the result of the sun's long continued action upon the nebulous matter of the three comets, correspond very nearly with the relative magnitudes of their nuclei, as indicated by observation; and hence the confirmation of Herschel's theory is complete. If this comparative view of comets be verified by more extended observations, it will serve to give some insight into the origin and arrangement of these bodies, and inform us of the true place which they occupy in the planetary system. Nor will it be the least important result of the establishment of this theory, that it will enable astronomers to arrange comets according to the various stages of maturity at which, in

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* Brande's Astron. ii. 31. I may here again advert to the difference in the measurements of this comet, made by Shröter and Herschel. If we assume the measurement given by the latter, it becomes even more favourable to the theory submitted in the text.

the progress of consolidation, they have arrived. Observation has, in fact, already furnished us with an extensive scale of comets, which are distinguishable by means of this important criterion. Several have been seen which had no nucleus at all, presenting only a gradual thickening towards the middle parts, which were nearly translucent; while, on the other hand, there are many whose condensation has proceeded so far, by having been more subjected to the action of the solar heat, as to have a nucleus 100, 1000, or even 2000 miles in diameter. Those of the latter description approach, in all the circumstances of their physical character, to the nature of planetary bodies; and particularly, like them, are less exposed to those sudden changes from the violent action of the sun's heat near their perihelion, which comets of a smaller size and a looser texture are observed to undergo.

" III. From these observations, we shall be the better able to estimate the probability of a supposition, perhaps it may be said more speculative than useful, but nevertheless founded on philosophical principles, whether or not comets be habitable bodies? It is very evident that such a supposition can never apply to the generality of comets; for, with regard to those whose consolidation is still only partial, the violent changes which take place in their constitution and structure, both at the perihelion and at the aphelion, are totally incompatible with all our ideas of either animal or vegetable existence. But with respect to those comets, whose advanced state of maturity renders the sun's influence incapable of materially affecting the surface of the nucleus, there seems to be no physical impossibility why many of them may not be the abode of living creatures, as well as the Earth and the other planets of the system.

" Yet considering the extremes of distance from the sun, at which the comets are placed in different parts of their eccentric orbits, it has been conceived, that the prodigious variations of heat and cold to which the inhabitants of a comet must be exposed, render the above supposition quite untenable. This, however, is an objection, which, though applicable to all comets, whatever be their state of consolidation, is truly more specious than substantial. Newton, indeed, calculated that the great Comet of 1680, which passed within 150,000 miles of the sun's surface, must have been heated to a temperature 2000 times greater than red hot iron. But the simple fact, that the comet, even if its density had exceeded that of iron itself, was not instantly dissipated by the violence of such a combustion, indicates some error in the data on which this calculation is founded. Still, though it should be allowed that the heat is not so great as Newton was inclined to estimate, it may be supposed that the variations of temperature to which a comet is subjected, are yet much too considerable for the existence and abode of beings, possessing constitutions at all analogous to those upon the Earth. But an application of the laws of chemical science to this subject, demonstrates that these extremes of heat and cold are by no means so excessive, as the mere alterations in the comet's distance from the sun might perhaps lead us to imagine.

"In the first place, it is well known, that, in the heating of bodies, when the compression to which they are subjected remains the same, there is a certain point, beyond which, whatever be the means employed, their temperature can never be elevated. Water, for instance, under the common atmospherical pressure, may be heated up as far as 212° of Fahrenheit; but all the heat which we employ in the endeavour to raise this temperature higher, is only dissipated in the ensuing evaporation. In like manner, the substance constituting a comet must have a certain point of its own, which, however near it may approach the sun, its mean temperature can never exceed. The tail of the comet may be expanded to a prodigious length, the nebulous envelope may become enlarged to an equal extent; even the materials on the surface of the nucleus, by volatilization, may pass into a gaseous or aërial form; but the planetary or solid body itself will experience no accession of heat beyond that point of maximum temperature, which its own nature and constitution determine.

"In the second place, we may observe, that when, by any means, the density of bodies is made to change, by a process, whether of rarefaction, on the one hand, or of condensation, on the other, they are always found to undergo a corresponding diminution or increase of temperature. When, therefore, in the approach of a comet to the sun, all the parts of its nebulous envelope and tail, which in the remoter regions of its course had been gathered close about the head, become expanded and attenuated, a very large proportion of the solar heat, which would otherwise have passed into the nucleus, and contributed to raise its temperature to a certain point, is carried off by the envelope and tail, in order to preserve an equilibrium among the several parts. Let us attempt to form some estimate of the actual loss of temperature thus sustained by the rarefaction. If we assume that the nebulous matter is elevated about 30 times its former height, the diminution of density, corresponding with the increase of volume, will amount to $(30)^3$, or 27,000; and employing the formula given in the Supplement to the Encyclopædia Britannica, article 'Climate,' we have

$45^\circ \times \{27{,}000 - \frac{1}{27{,}000}\}$, or nearly 1,215,000 degrees of Fahrenheit, for the quantity of caloric abtracted. Now, Newton, judging from the proximity of the Comet of 1680 to the sun at its perihelion, shews that its temperature ought to be about 2000 times greater than the temperature of iron red hot, or about 9000 times greater than the heat of boiling water; the boiling point of water being 212° of Fahrenheit, the sun communicated to this comet a supply of caloric amounting to 1,908,000°. But the loss, which, as we have just seen, must have been sustained by the rarefaction above supposed, amounted to two-thirds of this quantity; so that the actual influence of the sun, in raising the temperature of the comet, will undoubtedly be diminished in the same proportion. In a corresponding manner, when the comet retires towards its aphelion, where the heat of the sun becomes so much weakened on account of the distance, the condensation of the nebulous matter forming the tail and envelope serves not only to furnish the nucleus with continual supplies from the heat acquired at the perihelion, but even to render the warming influence of the solar rays much more efficacious than at a less remote part of the comet's orbit.

“It appears, then, that the variations of heat and cold, to which comets are exposed in the opposite points of their course, are by no means so great as to be incompatible with the supposition of their being fit abodes for animated beings: and if we recollect the facility with which our own bodies can adapt themselves to great and sudden extremes of temperature, as exemplified by various experiments, we may even conjecture these beings to possess a constitution not very dissimilar to that of the human species. Individuals, we know, have often allowed themselves to be confined for a considerable time in apartments heated to 260° and 280° of Fahrenheit, without feeling much inconvenience; and though we cannot as easily ascertain the extent to which cold may be endured by the human frame, we know that it is frequently exposed, without any injurious effects, to an intensity far surpassing what is necessary for the congelation of mercury*. In order, then, to be capable of sustaining those variations of temperature to which a comet may be subjected, it is not necessary that the constitution of its supposed inhabitants should be very different from the constitution of the beings belonging to the Earth. And when we recollect that these variations proceed in a gradual manner, not by the rapid transitions which we often experience on our own globe, the progress from one degree of temperature to another, as the comet journeys onward in its course, may be little perceived by its inhabitants. . . . . . .

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* Gay Lussac mentions, that natural cold has been observed, and therefore sustained by the human frame, so severe as—58° of Fahrenheit. *Brewster's Journal*, iii. 181.

"It is true that the atmosphere respired by these beings, while it is at one place a highly attenuated gas, is at another converted into a medium extremely dense; and therefore it may be difficult to conceive how animation can be supported in these opposite situations. But when Halley was able to breathe freely in a diving-bell, in which the compressed air was twelve times more dense than that on the tops of mountains,—and when the lungs, with all the other bodily organs, can so readily accommodate themselves to the most variable and trying circumstances, we do perceive how it is possible for respiration to be carried on, notwithstanding these changes in a comet's atmosphere, which, though undoubtedly extensive, yet take place in a slow, and therefore harmless, manner. Another objection has been started to the existence of living beings on comets, on account of the alternations of light and darkness to which, in the opposite portions of their orbit, they are thought to be exposed. But I find it remarked by Bailly, that the Comet of 1680, supposing it at the aphelion to be 138 times more distant from the sun than the Earth, ought for this reason to receive five times as much light from the sun as we do from the full moon; and when we add to this the superior density of the comet's atmosphere at this distant part of its orbit, it is capable of obtaining a still greater quantity of light by refraction *.

"These explanations, then, if they be deemed correct, make it appear that the several changes which are produced upon the constitution of a comet, in consequence of its varying distances from the sun, are not incompatible with our ideas of animated existence, and go so far as to render it not improbable, that the beings which inhabit comets may even possess bodily frames resembling those of terrestrial beings. But why, it may be asked, are we so solicitous to establish this resemblance between ourselves and the inhabitants of a comet, as if that were a condition which alone could render their existence possible? When we survey the wide field of animal organization which lies within the scope of our own experience, from Man, the proud lord of creation, to those tribes of zoophytes which we place lowest in the scale, do we not behold a continual succession of beings, as infinite in variety as in extent? If, then, upon the surface of our own little planet, we behold so diversified a picture of animal life, why should we deem it as either

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* Bailly, Hist. d'Astron. iii. 257.

unnatural or unlikely, that Comets may be the residence of beings widely different from those which fall within the narrow sphere of human observation. What though these beings, from the peculiarities of their situation, be endowed with neither lungs, nor eyes, nor the feelings which afford the sensations of heat and cold, like unto our bodily organs? Does this want imply either any improbability as to their existence, or even any inferiority, compared with ourselves, in the scale of creation? Most certainly not: For, if we estimate the intelligence of beings by the knowledge which their place in the universe is fitted to impart, we are compelled to regard the Cometary inhabitants as of an order even superior to the creatures of the Earth. When, for example, they find themselves passing through the midst of the satellites, those small bodies which we can scarcely discern with telescopes,—or when they are brought so close to the planet Saturn, that they can examine the wonderful phenomenon of his rings even with the naked eye,—or when at the perihelion passage, they are able to observe every thing on the surface of the Sun, that great luminary, the mysterious source of life, and light, and energy to the system;—what spectacles of delightful contemplation must they enjoy, and what means of attaining an acquaintance with the works of Nature, infinitely greater than any which we shall ever command! Traversing, as they do, the whole extent of that system of which the Earth forms so insignificant a member, and directing their course far beyond its known limits into those regions of space, whose dark and unfathomable nature it will for ever baffle human penetration to explore, the beings who have their abode on Comets must be familiar with many important truths, of which we can obtain only a few casual glimpses, and witness such glorious and sublime displays of the manifold wonders of creation, as must afford to them the noblest conception of that Almighty Being, by whose wisdom they were constructed, and by whose power they are still sustained.

On the Use of Ligatures and Bleeding in Cases of Poisoning.

IN a memoir, read lately by Dr Vernière to the French Academy of Sciences, on Certain Methods of treating all Cases of Poisoning, the author commenced with mentioning the experiments in which Magendie succeeded in completely suspending absorption in a dog, by producing an artificial plethora, by means of the injection of tepid water into the veins. Proceeding on this important fact, he made the following experiment. After putting three grains of alcoholic extract of nux vomica upon a wound made in the foot of a young dog, he applied a ligature above the humero-cubital articulation of the wounded limb. He then slowly injected, by the jugular vein, as much water as the animal could bear, without suffering much. After this, he opened the vein of the poisoned limb, below the ligature, and, taking away a few ounces of blood, injected them into the jugular vein of another dog. This dog died in convulsions at the very moment of injection. The wound of the first dog, however, having been carefully cleaned, a little blood was allowed to flow, and the animal was put at liberty. It exhibited no symptoms of poisoning, and eight days after was perfectly well, when it was sacrificed for other experiments.

The result of this experiment is easily accounted for. It being known that plethora stops absorption; the blood which flowed from the vein that was opened could alone be impregnated with poison, for that vein and its afferents were the only vessels that did not participate in the general plethora.

This experiment appeared decisive to M. Vernière. But the means of applying the principle which it affords to practice presents a great inconvenience,—the necessity of infusing water into the veins. This infusion, the author thinks, may be avoided, and that it is sufficient to induce a local plethora in the poisoned limb. Now, nothing is more easy than this, as it may be done by a moderately tight ligature. This ligature applied, it would be sufficient to open one of the veins of the engorged part, to determine the flow of the poisoned blood.

The author adduced two experiments in support of this method. In the first, three grains of extract of nux vomica were spread upon a wound made on the cheek of a small-sized dog. After an application of six minutes, during which the experimenter kept the two jugular veins compressed with his thumbs, that of the poisoned side was largely opened with a lancet, the blood flowed abundantly, and the animal, when restored to its feet, experienced only a little weakness.

In the other experiment, the author inserted under the skin of he anterior surface of the fore-leg of a young dog, three grains of the same extract. A tight ligature was, at the same time, applied to the limb. Five minutes after the application, the poison was removed by repeated washings; the ligature was removed, and the animal, being let loose, walked peaceably about. It was, however, soon seized with very violent convulsions. A large quantity of blood was immediately taken from the jugular vein, and the convulsions ceased. The animal, on being set at liberty, walked as before; only a few rattling inspirations were heard from time to time, which presently ceased. The author thought that, in this experiment, the ligature having been too tight, the artery had been compressed along with the vein, so that plethora could not have been produced.

From this experiment M. Vernière concludes, 1*st*, The inutility of too tight a ligature; 2*dly*, That, even after the poison has penetrated far into the torrent of the circulation, the evil is not beyond the resources of art, and that it is still possible, by means of large general bleedings, to expel the poison from the system.

It may, in fact, be easily conceived, and experiment proves it, that if bleeding is practised at an early period, when the poison is still contained in the large veins, the lungs, and the heart, it will pass, by preference, through the path where it finds less resistance; and consequently, the portion destined for the other organs must be diminished in the proportion of the blood that passes through the veins opened.

Hitherto the treatment of all cases of poisoning has been almost exclusively confined to removing the poison from the surface where it was deposited. No person ever dreamed of pursuing it into the veins, and still less of arresting it in the depths of the circulation. The experiments mentioned, reduce the treatment of all cases of poisoning, hydrophobia included, to a few precepts, so simple and so easily executed, that the most ordinary practitioner cannot fail to apprehend it.

On the Temperature of Springs in the vicinity of Colinton, near Edinburgh, in Latitude 55° 54′ 42″ N.; *Long.* 3° 16′ 8″ W.

THE following observations were continued from August 1827 to August 1828.

The springs issue from alluvium on the sides of the water of Leith, close to the village of Colinton: the spring A, from gravel; the spring B, from clay. Their height above the level of the high-water at spring-tides was accurately determined: spring A, was 366.8 feet, and spring B, 264.3 above the level mentioned. The observations on the temperature of the atmosphere were made some yards above the level of the spring A.

Detail of Observations.

1827,				
Aug. 22.	Spring	A, 48°;	spring	B, 49½°
30.	...	A, 48½°	...	B, 50°
Sept. 6.	...	A, 48½°	...	B, 50°
13.	...	A, 48°	...	B, 50½°
Oct. 2.	...	A, 48¼°	...	B, 50½°
10.	...	A, 48°	...	B, 49°
18.	...	A, 48¼°	...	B, 49°
		(wet weather).		
24.	...	A, 48½°	...	B, 49°
		(after great rains).		
Nov. 1.	...	A, 48°	...	B, 46°
9.	...	A, 48°	...	B, 47½°
16.	...	A, 48°	...	B, 46½°
24.	...	A, 47¼°	...	B, 46°
Dec. 6.	...	A, 47¾°	...	B, 46°
15.	...	A, 47½°	...	B, 46°
25.	...	A, 47½°	...	B, 45½°
1828,				
Jan. 6.	...	A, 47°		
19.	...	A, 47¼°	...	B, 45½°
27.	...	A, 47°	...	B, 46°
Feb. 10.	...	A, 46°	...	B, 43°
17.	...	A, 46°		
24.	...	A, 45½°	...	B, 43½°
1828,				
Mar. 2.	Spring	A, 46¼°		
9.	...	A, 46½°	...	B, 46¼°
16.	...	A, 47°	...	B, 46½°
23.	...	A, 45½°	...	B, 43¼°
April 4.	...	A, 45½°		
11.	...	A, 46°		
24.	...	A, 46°	...	B, 45½°
30.	...	A, 46°	...	B, 46¼°
May 13.	...	A, 46°	...	B, 47°
21.	...	A, 46½°	...	B, 47¼°
28.	...	A, 47½°	...	B, 49½°
June 11.	...	A, 47¾°	...	B, 50°
16.	...	A, 48°	...	B, 50°
24.	...	A, 49°	...	B, 51¼°
30.	...	A, 49½°	...	B, 51°
July 10.	...	A, 49¾°	...	B, 51½°
17.	...	A, 49°	...	B, 51°
23.	...	A, 49½°	...	B, 52¼°
28.	...	A, 49°	...	B, 51½°
Aug. 2.	...	A, 49°	...	B, 51½°
11.	...	A, 49½°	...	B, 52½°
		(after heavy rains).		
18.	...	A, 49½°	...	B, 51½°

Reduction of the Observations.

			Spring A.	Spring B.	Air.
			Mean.	Mean.	
1828,					
January,	Spring A,	47°, 47¼°, 47°, -	47°.08		41°.15
	... B,	45½, 46, -		45°.75	
February,	Spring A,	46, 46, 45½, -	45.84		40.22
	... B,	43, 43½,		43.25	
March,	Spring A,	46¼, 46½, 47, 45½,	46.31		42.14
	... B,	46½, 46¼, 43¼, -		45.33	
April,	Spring A,	45½, 46, 46, 46, -	45.88		45.10
	... B,	45½, 46¼, -		45.87	
May,	Spring A,	46, 46½, 47½, -	46.66		53.62
	... B,	47, 47¼, 49½, -		47.91	
June,	Spring A,	47¾, 48, 49, 49½,	48.44		60.05
	... B,	50, 50, 51¼, 51,		50.56	
July,	Spring A,	49¾, 49, 49¼, 49,	49.25		
	... B,	51½, 51, 52¼, 51½,		51.56	63.21
1828 & 1827,					
August,	Spring A,	49, 49½, 49¼ : 48, 48½,	48.85		57.82
	... B,	51½, 52½, 51½ : 49½, 50,		51.00	
1827,					
September,	Spring A,	48½, 48, -	48.25		54.76
	... B,	50, 50½, -		50.25	
October,	Spring A,	48½, 48, 48¼, 48½,	48.31		51.13
	... B,	50½, 49, 49, 49,		49.37	
November,	Spring A,	48, 48, 48, 47¼,	47.81		42.86
	... B,	46, 47½, 46½, 46,		46.50	
December,	Spring A,	47¾, 47½, 47½,	47.58		43.40
	... B,	46, 46, 45½, -		45.84	
		Sums,.........	570.26	573.19	595.46
		Mean Results,.........	47.52	47.76	49.62
Correction of Annual Temp. at 8 A. M. and 8 P. M. to the Mean,					+ 0.44
		True Mean Temp.			50.08

With regard to the last column, it may be remarked that it contains the mean result of observations made daily at 8 A. M. and 8 P. M. from August 16. 1827 to August 15. 1828, both inclusive. It exhibits clearly the extraordinary mildness of the season, which appears to have raised the temperature of the air more than two degrees above that of the earth, as shewn by the springs. The reduction of the annual temperature, as observed at 8 A. M. and 8 P. M. is taken from the Report of the hourly observations at Leith. The difference of 0°.24 between the two springs is attributable to their difference of level, to which it nearly corresponds. The atmospheric temperature for August is a mean of the first half of that month in 1828, and the second in 1827.

J. D. F.

A Brief Account of Microscopical Observations made in the Months of June, July, and August 1827, *on the Particles contained in the Pollen of Plants; and on the General Existence of active Molecules in Organic and Inorganic Bodies.* By **Robert Brown**, F.R.S, Hon. M.R.S.E. and R.I. Acad., V.P. L.S. &c. &c. [*]

THE observations, of which it is my object to give a summary in the following pages, have all been made with a simple microscope, and indeed with one and the same lens, the focal length of which is about $\frac{1}{32}$d of an inch[†].

The examination of the unimpregnated vegetable ovulum, an account of which was published early in 1826[‡], led me to attend more minutely than I had done before to the structure of the pollen, and to inquire into its mode of action on the pistillum in phænogamous plants.

In the essay referred to, it was shown that the apex of the nucleus of the ovulum, the point which is universally the seat of the future embryo, was very generally brought into contact with the terminations of the probable channels of fecundation; these being either the surface of the placenta, the extremity of the descending processes of the style, or more rarely, a part of the surface of the umbilical cord. It also appeared, however, from some of the facts noticed in the same essay, that there were cases in which the particles contained in the grains of pollen could hardly be conveyed to that point of the ovulum through the vessels or cellular tissue of the ovarium; and the knowledge of these cases, as well as of the structure and economy of the antheræ in Asclepiadeæ, had led me to doubt the correctness of observations made by Stiles and Gleichen upwards of sixty years ago, as well as of some very recent statements, respecting the mode of action of the pollen in the process of impregnation.

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[*] This important and highly interesting Memoir was sent us by our friend Mr Brown, and, although not published, we believe we are not acting contrary to the wishes of the author in giving it an early place in the Edinburgh Philosophical Journal.

[†] This double convex lens, which has been several years in my possession, I obtained from Mr Bancks, optician in the Strand. After I had made considerable progress in the inquiry, I explained the nature of my subject to Mr Dollond, who obligingly made for me a simple pocket microscope, having very delicate adjustment, and furnished with excellent lenses, two of which are of much higher power than that above mentioned. To these I have often had recourse, and with great advantage, in investigating several minute points. But to give greater consistency to my statements, and to bring the subject as much as possible within the reach of general observation, I continued to employ throughout the whole of the inquiry the same lens with which it was commenced.

[‡] In the Botanical Appendix to Captain King's Voyages to Australia, vol. ii. p. 534, *et seq.*

It was not until late in the autumn of 1826 that I could attend to this subject; and the season was too far advanced to enable me to pursue the investigation. Finding, however, in one of the few plants then examined, the figure of the particles contained in the grains of pollen clearly discernible, and that figure not spherical but oblong, I expected, with some confidence, to meet with plants in other respects more favourable to the inquiry, in which those particles, from peculiarity of form, might be traced through their whole course: and thus, perhaps, the question determined whether they in any case reach the apex of the ovulum, or whether their direct action is limited to other parts of the female organ.

My inquiry on this point was commenced in June 1827, and the first plant examined proved in some respects remarkably well adapted to the object in view.

This plant was *Clarckia pulchella*, of which the grains of pollen, taken from antheræ full grown, but before bursting, were filled with particles or granules of unusually large size, varying from nearly $\frac{1}{4000}$th to about $\frac{1}{5000}$th of an inch in length, and of a figure between cylindrical and oblong, perhaps slightly flattened, and having rounded and equal extremities. While examining the form of these particles immersed in water, I observed many of them very evidently in motion; their motion consisting not only of a change of place in the fluid, manifested by alterations in their relative positions, but also not unfrequently of a change of form in the particle itself; a contraction or curvature taking place repeatedly about the middle of one side, accompanied by a corresponding swelling or convexity on the opposite side of the particle. In a few instances the particle was seen to turn on its longer axis. These motions were such as to satisfy me, after frequently repeated observation, that they arose neither from currents in the fluid, nor from its gradual evaporation, but belonged to the particle itself.

Grains of pollen of the same plant taken from antheræ immediately after bursting, contained similar subcylindrical particles, in reduced numbers, however, and mixed with other particles, at least as numerous, of much smaller size, apparently spherical, and in rapid oscillatory motion.

These smaller particles, or molecules, as I shall term them, when first seen, I considered to be some of the cylindrical particles swimming vertically in the fluid. But frequent and careful examination lessened my confidence in this supposition; and on continuing to observe them until the water had entirely evaporated, both the cylindrical particles and spherical molecules were found on the stage of the microscope.

In extending my observations to many other plants of the same natural family, namely Onagrariæ, the same general form and similar motions of particles were ascertained to exist, especially in the various species of Œnothera, which I examined. I found also in their grains of pollen taken from the antheræ immediately after bursting, a manifest reduction in the proportion of the cylindrical or oblong particles, and a corresponding increase in that of the molecules, in a less remarkable degree, however, than in Clarckia.

This appearance, or rather the great increase in the number of the molecules, and the reduction in that of the cylindrical particles, before the grain of pollen could possibly have come in contact with the stigma,—were perplexing circumstances in this stage of the inquiry, and certainly not favourable to the supposition of the cylindrical particles acting directly on the ovulum; an opinion which I was inclined to adopt, when I first saw them in motion. These circumstances, however, induced me to multiply my observations, and I accordingly examined numerous species of many of the more important and remarkable families of the two great primary divisions of phænogamous plants.

In all these plants particles were found, which in the different families or genera varied in form from oblong to spherical, having manifest motions similar to those already described; except that the change of form in the oval and oblong particles was generally less obvious than in Onagrariæ, and in the spherical particle was in no degree observable*. In a great proportion of these plants I also remarked the same reduction of the larger particles, and a corresponding increase of the molecules after the bursting of the antheræ; the molecule, of apparently uniform size and form, being then always present; and in some cases indeed, no other particles were observed, either in this or in any early stage of the secreting organ.

In many plants belonging to several different families, but especially to Gramineæ, the membrane of the grain of pollen is so transparent, that the motion of the larger particles within the entire grain was distinctly visible; and it was manifest also at the more transparent angles, and in some cases even in the body of the grain in Onagrariæ.

In Asclepiadeæ, strictly so called, the mass of pollen filling each cell of the anthera is in no stage separable into distinct grains; but within, its tesselated or cellular membrane is filled with spherical particles, commonly of two sizes. Both these kinds of particles, when immersed in water, are generally seen in vivid motion; but the apparent motions of the larger particle might in these cases perhaps be caused by the rapid oscillation of the more numerous molecules. The mass of pollen in this tribe of plants never bursts, but merely connects itself by a determinate point, which is not unfrequently semitransparent, to a process of nearly similar consistence, derived from the gland of the corresponding angle of the stigma.

In Periploceæ, and in a few Apocineæ, the pollen, which in these plants is separable into compound grains filled with spherical moving particles, is applied to processes of the stigma, analogous to those of Asclepiadeæ. A similar economy exists in Orchideæ, in which the pollen masses are always, at least in the early stage, granular; the grains, whether simple or compound, containing minute, nearly spherical particles, but the whole mass being, with a very few exceptions, connected by a determinate point of its surface with the stigma or glandular process of that organ.

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* In Lolium perenne, however, which I have more recently examined, though the particle was oval and of smaller size than in Onagrariæ, this change of form was at least as remarkable, consisting in an equal contraction in the middle of each side, so as to divide it into two nearly orbicular portions.

Having found motion in the particles of the pollen of all the living plants which I had examined, I was led next to inquire whether this property continued after the death of the plant, and for what length of time it was retained.

In plants, either dried or immersed in spirit for a few days only, the particles of pollen of both kinds were found in motion equally evident with that observed in the living plant; specimens of several plants, some of which had been dried and preserved in an herbarium for upwards of twenty years, and others not less than a century, still exhibited the molecules or smaller spherical particles in considerable numbers, and in evident motion, along with a few of the larger particles, whose motions were much less manifest, and in some cases not observable *.

In this stage of the investigation, having found, as I believed, a peculiar character in the motions of the particles of pollen in water, it occurred to me to appeal to this peculiarity as a test in certain families of Cryptogamous plants, namely, Mosses, and the genus Equisetum, in which the existence of sexual organs had not been universally admitted.

In the supposed stamina of both these families, namely, in the cylindrical antheræ or pollen of Mosses, and on the surface of the four spathulate bodies surrounding the naked ovulum, as it may be considered, of Equisetum, I found minute spherical particles, apparently of the same size with the molecule described in Onagrariæ, and having equally vivid motion on immersion in water; and this motion was still observable in specimens both of Mosses and of Equiseta, which had been dried upwards of one hundred years.

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* While this sheet was passing through the press, I have examined the pollen of several flowers which have been immersed in weak spirit about eleven months, particularly of *Viola tricolor*, *Zizania aquatica*, and *Zea Mays*; and in all these plants the peculiar particles of the pollen, which are oval or short oblong, though somewhat reduced in number, retain their form perfectly, and exhibit evident motion, though, I think, not so vivid as in those belonging to the living plant. In *Viola tricolor*, in which, as well as in other species of the same natural section of the genus, the pollen has a very remarkable form, the grain on immersion in nitric acid still discharged its contents by its four angles, though with less force than in the recent plant.

The very unexpected fact of seeming vitality retained by these minute particles so long after the death of the plant, would not perhaps have materially lessened my confidence in the supposed peculiarity. But I at the same time observed, that, on bruising the ovula or seeds of Equisetum, which at first happened accidentally, I so greatly increased the number of moving particles, that the source of the added quantity could not be doubted. I found also, that, on bruising first the floral leaves of Mosses, and then all other parts of those plants that I readily obtained similar particles, not in equal quantity indeed, but equally in motion. My supposed test of the male organ was therefore necessarily abandoned.

Reflecting on all the facts with which I had now become acquainted, I was disposed to believe that the minute spherical particles or molecules of apparently uniform size, first seen in the advanced state of the pollen of Onagrariæ, and most other Phænogamous plants,—then in the antheræ of Mosses, and on the surface of the bodies regarded as the stamina of Equisetum,—and, lastly, in bruised portions of other parts of the same plants, were in reality the supposed constituent or elementary molecules of organic bodies, first so considered by Buffon and Needham, then by Wrisberg with greater precision, soon after and still more particularly by Müller, and, very recently, by Dr Milne Edwards, who has revived the doctrine, and supported it with much interesting detail. I now, therefore, expected to find these molecules in all organic bodies; and, accordingly, on examining the various animal and vegetable tissues, whether living or dead, they were always found to exist; and merely by bruising these substances in water, I never failed to disengage the molecules in sufficient numbers to ascertain their apparent identity in size, form, and motion, with the smaller particles of the grains of pollen.

I examined also various products of organic bodies, particularly the gum resins, and substances of vegetable origin, extending my inquiry even to pit-coal; and in all these bodies molecules were found in abundance. I remark here also, partly as a caution to those who may hereafter engage in the same inquiry, that the dust or soot deposited on all bodies in such quantity, especially in London, is entirely composed of these molecules.

One of the substances examined, was a specimen of fossil wood, found in Wiltshire oolite, in a state to burn with flame; and as I found these molecules abundantly, and in motion in this specimen, I supposed that their existence, though in smaller quantity, might be ascertained in mineralized vegetable remains. With this view a minute portion of silicified wood, which exhibited the structure of Coniferæ, was bruised, and spherical particles, or molecules in all respects like those so frequently mentioned, were readily obtained from it; in such quantity, however, that the whole substance of the petrifaction seemed to be formed of them. But hence I inferred that these molecules were not limited to organic bodies, nor even to their products.

To establish the correctness of the inference, and to ascertain to what extent the molecules existed in mineral bodies, became the next object of inquiry. The first substance examined was a minute fragment of window-glass, from which, when merely bruised on the stage of the microscope, I readily and copiously obtained molecules agreeing in size, form, and motion with those which I had already seen.

I then proceeded to examine, and with similar results, such minerals as I either had at hand or could readily obtain, including several of the simple earths and metals, with many of their combinations.

Rocks of all ages, including those in which organic remains have never been found, yielded the molecules in abundance. Their existence was ascertained in each of the constituent minerals of granite, a fragment of the Sphinx being one of the specimens examined.

To mention all the mineral substances in which I have found these molecules, would be tedious; and I shall confine myself in this summary to an enumeration of a few of the most remarkable. These were both of aqueous and igneous origin, as travertine, stalactites, lava, obsidian, pumice, volcanic ashes, and meteorites from various localities *. Of metals I may mention manganese, nickel, plumbago, bismuth, antimony, and

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* I have since found the molecules in the sand-tubes, formed by lightning, from Drig in Cumberland.

arsenic. In a word, in every mineral which I could reduce to a powder, sufficiently fine to be temporarily suspended in water, I found these molecules more or less copiously; and in some cases, more particularly in silicious crystals, the whole body submitted to examination appeared to be composed of them.

In many of the substances examined, especially those of a fibrous structure, as asbestus, actinolite, tremolite, zeolite, and even steatite, along with the spherical molecules, other corpuscules were found, like short fibres somewhat moniliform, whose transverse diameter appeared not to exceed that of the molecule of which they seemed to be primary combinations. These fibrils, when of such length as to be probably composed of not more than four or five molecules, and still more evidently when formed of two or three only, were generally in motion, at least as vivid as that of the simple molecule itself; and which from the fibril often changing its portion in the fluid, and from its occasional bending, might be said to be somewhat vermicular.

In other bodies which did not exhibit these fibrils, oval particles of a size about equal to two molecules, and which were also conjectured to be primary combinations of these, were not unfrequently met with, and in motion generally more vivid than that of the simple molecule; their motion consisting in turning usually on their longer axis, and then often appearing to be flattened. Such oval particles were found to be numerous and extremely active in white arsenic.

As mineral bodies which had been fused contained the moving molecules as abundantly as those of alluvial deposits, I was desirous of ascertaining whether the mobility of the particles existing in organic bodies was in any degree affected by the application of intense heat to the containing substance. With this view small portions of wood, both living and dead, linen, paper, cotton, wool, silk, hair, and muscular fibres, were exposed to the flame of a candle, or burned in platina forceps, heated by the blowpipe; and in all these bodies so heated, quenched in water, and immediately submitted to examination, the molecules were found, and in as evident motion as those obtained from the same substances before burning.

In some of the vegetable bodies burned in this manner, in addition to the simple molecules, primary combinations of these were observed, consisting of fibrils having transverse contractions, corresponding in number, as I conjectured, with that of the molecules composing them; and those fibrils, when not consisting of a greater number than four or five molecules, exhibited motion, resembling in kind and vivacity that of the mineral fibrils already described, while longer fibrils of the same apparent diameter were at rest.

The substance found to yield these active fibrils in the largest proportion and in the most vivid motion, was the mucous coat interposed between the skin and muscles of the haddock, especially after coagulation by heat.

The fine powder produced on the under surface of the fronds of several ferns, particularly of *Achrostichum calomelanos*, and the species nearly related to it, was found to be entirely composed of simple molecules, and their primary fibre-like compounds, both of them being evidently in motion.

There are three points of great importance which I was anxious to ascertain respecting these molecules, namely, their form, whether they are of uniform size, and their absolute magnitude. I am not, however, entirely satisfied with what I have been able to determine on any of these points.

As to form, I have stated the molecule to be spherical, and this I have done with some confidence; the apparent exceptions which occurred admitting, as it seems to me, of being explained by supposing such particles to be compounds. This supposition in some of the cases is indeed hardly reconcileable with their apparent size, and requires for its support the further admission, that, in combination, the figure of the molecule may be altered. In the particles formerly considered as primary combinations of molecules, a certain change of form must also be allowed; and even the simple molecule itself has sometimes appeared to me when in motion to have been slightly modified in this respect.

My manner of estimating the absolute magnitude and uniformity in size of the molecules, found in the various bodies submitted to examination, was by placing them on a micrometer divided to five-thousandths of an inch, the lines of which were very distinct; or more rarely on one divided to ten thousandths, with fainter lines, not readily visible without the application of plumbago, as employed by Dr Wollaston, but which in my subject was inadmissible.

The results so obtained can only be regarded as approximations, on which perhaps, for an obvious reason, much reliance will not be placed. From the number and degree of accordance of my observations, however, I am upon the whole disposed to believe the simple molecule to be of uniform size, though, as existing in various substances and examined in circumstances more or less favourable, it is necessary to state that its diameter appeared to vary from $\frac{1}{15,000}$th to $\frac{1}{20,000}$th of an inch *.

I shall not at present enter into additional details, nor shall I hazard any conjectures whatever respecting these molecules, which appear to be of such general existence in inorganic as well as in organic bodies; and it is only farther necessary to mention the principal substances from which I have not been able to obtain them. These are oil, resin, wax, and sulphur, such of the metals as I could not reduce to that minute state of division necessary for their separation, and finally, bodies soluble in water.

In returning to the subject with which my investigation commenced, and which was indeed the only object I originally had in view, I had still to examine into the probable mode of action of the larger or peculiar particles of the pollen, which, though in many cases diminished in number before the grain could possibly have been applied to the stigma, and particularly in Clarckia, the plant first examined, were yet in many other plants found in less diminished proportion, and might in nearly all cases be supposed to exist in sufficient quantity to form the essential agents in the process of fecundation.

I was now therefore to inquire, whether their action was confined to the external organ, or whether it were possible to follow them to the nucleus of the ovulum itself. My endeavours, however, to trace them through the tissue of the style in plants well suited for this investigation, both from the size and form of the particles, and the development of the female parts, particularly Onagrariæ, was not attended with success; and neither in this

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* While this sheet was passing through the press, Mr Dollond, at my request, obligingly examined the supposed pollen of *Equisetum virgatum* with his compound achromatic microscope, having in its focus a glass divided into 10,000ths of an inch, upon which the object was placed; and although the greater number of particles or molecules seen were about $\frac{1}{20,000}$, yet the smaller did no exceed $\frac{1}{30,000}$th of an inch.

nor in any other tribe examined, have I ever been able to find them in any part of the female organ, except the stigma. Even in those families in which I have supposed the ovulum to be naked, namely, Cycadeæ and Coniferæ, I am inclined to think that the direct action of these particles, or of the pollen containing them, is exerted rather on the orifice of the proper membrane than on the apex of the included nucleus; an opinion which is in part founded on the partial withering confined to one side of the orifice of that membrane in the larch,—an appearance which I have remarked for several years.

To observers not aware of the existence of the elementary active molecules, so easily separated by pressure from all vegetable tissues, and which are disengaged and become more or less manifest in the incipient decay of semitransparent parts, it would not be difficult to trace granules through the whole length of the style: and as these granules are not always visible in the early and entire state of the organ, they would naturally be supposed to be derived from the pollen, in those cases at least in which its contained particles are not remarkably different in size and form from the molecule.

It is necessary also to observe, that in many, perhaps I might say in most plants, in addition to the molecules separable from the stigma and style before the application of the pollen, other granules of greater size are obtained by pressure, which in some cases closely resemble the particles of the pollen in the same plants, and in a few cases even exceed them in size: these particles may be considered as primary combinations of the molecules, analogous to those already noticed in mineral bodies and in various organic tissues.

From the account formerly given of Asclepiadeæ, Periploceæ, and Orchideæ, and particularly from what was observed of Asclepiadeæ, it is difficult to imagine, in this family at least, that there can be an actual transmission of particles from the mass of pollen, which does not burst, through the process of the stigma; and even in these processes I have never been able to observe them, though they are in general sufficiently transparent to show the particles, were they present. But if this be a correct statement of the structure of the sexual organs in Asclepiadeæ, the question respecting this family would no longer be, whether the particles in the pollen were transmitted through the stigma and style to the ovula, but rather whether even actual contact of these particles with the surface of the stigma were necessary to impregnation.

Finally, it may be remarked, that those cases already adverted to, in which the apex of the nucleus of the ovulum, the supposed point of impregnation, is never brought into contact with the probable channels of fecundation, are more unfavourable to the opinion of the transmission of the particles of the pollen to the ovulum, than to that which considers the direct action of these particles as confined to the external parts of the female organ.

The observations, of which I have now given a brief account, were made in the months of June, July, and August, 1827. Those relating merely to the form and motion of the peculiar particles of the pollen were stated, and several of the objects shown, during these months, to many of my friends, particularly to Messrs Bauer and Bicheno, Dr Bostock, Dr Fitton, Mr E. Forster, Dr Henderson, Sir Everard Home, Captain Home, Dr Horsfield, Mr Koenig, M. Lagasca, Mr Lindley, Dr Maton, Mr Menzies, Dr Prout, Mr Renouard, Dr Roget, Mr Stokes, and Dr Wollaston; and the general existence of the active molecules in inorganic as well as organic bodies, their apparent indestructibility by heat; and several of the facts respecting the primary combinations of the molecules, were communicated to Dr Wollaston and Mr Stokes in the last week of August.

None of these gentlemen are here appealed to for the correctness of any of the statements made; my sole object in citing them being to prove from the period and general extent of the communication, that my observations were made within the dates given in the title of the present summary.

The facts ascertained respecting the motion of the particles of the pollen, were never considered by me as wholly original; this motion having, as I knew, been obscurely seen by Needham, and distinctly by Gleichen, who not only observed the motion of the particles in water after the bursting of the pollen, but in several cases remarked their change of place within the entire grain. He has not, however, given any satisfactory account either of the forms or of the motions of these particles, and in some cases appears to have confounded them with the elementary molecule, whose existence he was not aware of.

Before I engaged in the inquiry in 1827, I was acquainted only with the abstract given by M. Adolphe Brongniart himself, of a very elaborate and valuable memoir, entitled "*Recherches sur la Génération et le Développement de l'Embryon dans les Végétaux Phanerogames*," which he had then read before the Academy of Sciences of Paris, and has since published in the *Annales des Sciences Naturelles*.

Neither in the abstract referred to, nor in the body of the memoir, which M. Brongniart has, with great candour, given in its original state, are there any observations, appearing of importance even to the author himself, on the motion or form of the particles; and the attempt to trace these particles to the ovulum with so imperfect a knowledge of their distinguishing characters, could hardly be expected to prove satisfactory. Late in the autumn of 1827, however, M. Brongniart having at his command a microscope constructed by Amici, the celebrated Professor of Modena, he was enabled to ascertain many important facts on both these points, the result of which he has given in the notes annexed to his memoir. On the general accuracy of his observations on the motions, form, and size of the granules, as he terms the particles, I place great reliance. But, in attempting to trace these particles through their whole course, he has overlooked two points of the greatest importance in the investigation.

For, in the *first* place, he was evidently unacquainted with the fact, that the active spherical molecules generally exist in the grain of pollen along with its proper particles; nor does it appear from any part of his memoir that he was aware of the existence of molecules having spontaneous or inherent motion, and distinct from the peculiar particles of the pollen, though he has doubtless seen them, and in some cases, as it seems to me, described them as those particles.

Secondly, He has been satisfied with the external appearance of the parts in coming to his conclusion, that no particles capable of motion exist in the style or stigma before impregnation.

That both simple molecules and larger particles of different form, and equally capable of motion, do exist in these parts, before the application of the pollen to the stigma can possibly take place, in many of the plants submitted by him to examination, may easily be ascertained; particularly in *Antirrhinum majus*, of which he has given a figure in a more advanced state, representing these molecules or particles, which he supposes to have been derived from the grains of pollen, adhering to the stigma.

There are some other points respecting the grains of pollen and their contained particles, in which I also differ from M. Brongniart, namely, in his supposition that the particles are not formed in the grain itself, but in the cavity of the anthera; in his assertion respecting the presence of pores on the surface of the grain in its early state through which the particles formed in the anthera, pass into its cavity; and, *lastly*, on the existence of a membrane forming the coat of his boyau or mass of cylindrical form ejected from the grain of pollen.

I reserve, however, my observations on these and several other topics connected with the subject of the present inquiry, for the more detailed account which it is my intention to give.

July 30. 1828.

Description of several New or Rare Plants which have flowered in the neighbourhood of Edinburgh, and chiefly in the Royal Botanic Garden, during the last three months. By Dr Graham.

1*st Sept.* 1828.

Calceolaria arachnoidea.

C. *arachnoidea;* caule herbaceo, ramoso, patulo, foliisque lingulato-oblongis, subdentatis, oppositis, lanato; pedunculis terminalibus, geminatis, elongatis, dichotomis; calycibus pedicellisque arachnoideis.

Description.—*Stem* herbaceous, round, much branched, spreading, succulent, woolly, hairs adpressed. *Branches* opposite, spreading, similar to the stem. *Leaves* (with their petioles about 5 inches long,) opposite, lingulato-oblong, narrowing downwards into long petioles over which they are decurrent, stem clasping, obscurely toothed, wrinkled, woolly on both sides, middle rib and branching veins prominent on the lower side; two uppermost leaves smaller than the others, sessile, cordato-ovate, undulate, and placed at the origin of the peduncles. *Peduncles* terminal, geminate (6 inches long), dichotomous, branches spreading, and bearing the pedicels in pairs. *Pedicels* round, undivided, and with the calyx involved in a cobweb-like tomentum. *Bracteæ* 2, opposite, at the bifurcation of the peduncle, like the uppermost leaves, but smaller. Perhaps it would be more correct to consider the peduncle as beginning a joint lower (8 inches lower) than I have done, when it must be looked upon as single, bifid, and the two upper leaves must be held as bracteæ. *Calyx* segments equal, ovate, pointed, spreading, woolly on the outside. *Corolla* of uniform dull purple colour, subglobular, flattened below, glabrous within, upper lip very small, lower crenated, its neck white. *Stamens* rising from the base of the corolla at its sides; filaments straight, stout, smooth, supporting the elongated bilocular anthers by their middle in contact with the edge of the upper lip of the corolla; pollen yellow.

Germen conical, grooved in its sides. *Style* straight, filiform, exserted. *Stigma* simple, small. *Ovules* very numerous, attached to a large central receptacle, the transverse section of which in each loculament is emarginate. Surface of the germen, outside of the corolla and inside of the calyx, covered with short, obscure, glandular pubescence.

We received the seeds of this plant from our invaluable correspondent Dr Gillies at Mendoza in January last, having been collected by him in Chili. It has been treated like all the other species of the genus, and hitherto kept in the greenhouse. There is great probability that it may not produce seed; but it strikes very readily by cuttings, the branches even pushing down roots as they lie along the ground.

We fear it will be more difficult to preserve the only other purple *Calceolaria* in cultivation (*Calceolaria purpurea*, Edin. New Phil. Journ. 1827, Bot. Mag. t. 2775.), also introduced through the Botanic Garden, Edinburgh, by seeds sent from our other excellent correspondent Mr Cruckshanks. It has hitherto produced very few seeds, but there is at present a better promise than has before been observed. An entirely new aspect has been given to our greenhouses within these few years, by the kindness of Dr Gillies and Mr Cruckshank, particularly in the most interesting additions from the genera *Fuchsia*, *Calceolaria*, *Salpiglossis*, *Schizanthus*, and *Loasa*.

Calceolaria connata.

C. *connata*; caule erecto, herbaceo, ramoso, pubescenti; foliis oppositis, utrinque pubescentibus, inferioribus in petiolos attenuatis, duplicato dentato-serratis, superioribus ovatis, sessilibus, connatis, dentato-serratis, floralibus integerrimis; corollæ labiis oblongis, compressis, parallelis.

Calceolaria connata, *Hook*. MS.

DESCRIPTION.—*Root* perennial. *Stem* (2 feet high) herbaceous, erect, much branched, pubescent: the pubescence is glutinous, and increases upwards on the plant to the calyx and germen, where it is greatest. *Lower leaves* (7 inches long, 4 broad,) ovate, subacute, attenuated at the base, and broadly decurrent along petioles half their own length, unequally and occasionally doubly, tooth serrated, membranous, veined, slightly pubescent on both sides, veins oblique and branched; *upper leaves* opposite, gradually becoming cordate and sessile towards the top, connate, in other respects similar to the lower leaves. *Racemes* solitary and axillary, or terminal and geminate, (6–15 inches long). *Common peduncles* bifid below the middle, spreading, flexuose, and frequently each branch is again cleft. *Pedicels* secund, simple, in pairs, (about 1 inch long), shorter upwards, filiform, two remote from the others in the bifurcation of the peduncle. *Bracteæ* 2 at each bifurcation of the peduncle, similar to the upper leaves, but entire in their edge, and smaller. *Calyx* segments ovate, acute, indistinctly 3-nerved, spreading, revolute in the edges. *Corolla* pale uniform yellow, shortly pubescent externally, lips oblong, compressed, parallel, the upper more than half the length of the lower, and its edge slightly involute, edge of the lower lip folded even to its base, and there again involute, thickened, and greenish. *Stamens* arising from the corolla at the sides of its base, included; filaments straight, smooth, and bearing the incumbent, oblique, whitish, anthers in contact with the edge of the upper lip; pollen nearly white. *Germen* bilocular, conical, acuminate, tetragonous. *Style* longer than the stamens, subexserted, and projecting from the centre of the anthers, marcescent. *Stigma* small, blunt. *Ovulæ* numerous, attached to a central receptacle, the transverse section of which is bifid in each loculament.

We received this species from the Royal Botanic Garden, Glasgow, where it was raised from seed; but through what channel it was received there, or from what district in South America, I do not know. In the arrangement of the species, it should stand next to *C. petiolaris*.

Calceolaria thyrsiflora.

C. thyrsiflora; fruticosa, ramosa, foliis oppositis, linearibus, basi attenuatis, lineatis, serrato-dentatis, glabris, viscosis, sessilibus, thyrsis terminalibus, confertis, pedicellis decompositis, umbellatis.

DESCRIPTION.—*Shrub*, erect; *stem* round, bark brown, cracked; *branches* spreading at their origin, afterwards erect, when young somewhat rough and obscurely glandular. *Leaves* (2 inches long, 2 lines broad), opposite, sessile, spreading, linear, subacute, becoming narrower towards their base, channelled, lineate, keeled behind, rather distantly serrato-dentate, whole edge but particularly the teeth reflected, without hairs, as well as the peduncles and pedicels shining on both surfaces from a viscid exudation. *Common peduncles* terminal, elongated, nearly naked below, the upper leaves passing into *bracteæ*, and becoming entire: *pedicels* rise from the axils of these, and are once, twice, or oftener divided in form of little umbels, having at each subdivision a pair of bracteæ, similar, but successively smaller; ultimate division of the pedicels longer than the flowers. *Flowers* yellow, crowded in form of a handsome thyrsus at the extremity of each branch. *Calyx* yellowish-green 4-parted, segments (¼th of an inch long) ovato-lanceolate, glandular, on both surfaces, unequal, slightly divaricated, but after the corolla falls closing over the germen, obscurely nerved. *Corolla* subglobular, nearly twice as long as the calyx, glabrous on the outside, except a slight pubescence where the closed lips touch, pubescent within, especially towards the base, obscurely striated, depressed at its base, closed, lower lip larger than the upper; stamens projecting into a depression in the lower lip; filaments rising from the base of the lower lip, hairy, stout, slightly curved upwards, pitted on their lower side near to the anthers. *Anthers* pale yellow, placed transversely on the filaments, bilobular, lobes connected to each other longitudinally, and furrowed along their anterior surface, where they burst and discharge white pollen. *Germen* conical, furrowed on two sides, bilocular, green, viscid. *Style* filiform, straight, longer than the stamens; *stigma* small; *ovula* very numerous, attached to a large central receptacle, the transverse section of which is kidney-shaped and entire in each loculament.

This very handsome and nondescript species was raised both at the Botanic Garden and in the collection of P. Neill, Esq. Canonmills, Edinburgh, in 1827, from seeds received from Dr Gillies, Mendoza; but our only plant was lost during winter. With Mr Neill, several specimens have flowered freely in July 1828. The flowers have a slight fragrance, not unlike the scent of the blossoms of laburnum.

Collomia grandiflora.

C. *grandiflora*; foliis sessilibus, lanceolatis, ciliatis, integerrimis serratisve, patulis, nitidis, superioribus utrinque pubescentibus; floribus capitatis terminalibus.

Collomia grandiflora, *Douglas*, Journ. ined.—*Lindley*, in Bot. Reg. fol. 1166. note [*].

DESCRIPTION.—*Root* tapering, with many lateral branching fibres, annual. *Stem* (18 inches high) erect, somewhat woody, very slightly flexuose, furrowed, red, pubescent, especially towards the top, branched; branches axillary. *Leaves* (above 2 inches long, ½ inch broad,) scattered, spreading, lanceolate, undulate, reflected and entire on the edges, or with a few large, sharp serratures, glabrous and shining, except the upper ones, which are ovate and pubescent on both sides; middle rib strong and prominent behind, veins few and inconsiderable. *Flowers* in terminal, very viscid capitula, sessile among the upper leaves; that at the termination of the stem large, dense, and hemispherical. *Calyx* 5-cleft to below the middle, segments united below by a transparent membrane, lanceolate, blunt, green, 3-nerved, pubescent within and without. *Co-*

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[*] Since this sheet was in types, I have received the number of the Botanical Register for this month, with an excellent figure of this plant, t. 1174.

rolla (above 1 inch long) inferior, flesh-coloured, funnel-shaped, twice the length of the calyx, throat inflated, limb 5-cleft, upper segments reflected, lower suberect, blunt, tube very slender, slightly dilated at its base to cover the germen. *Stamens* 5; filaments unequal, adhering to the inside of the tube, but for a considerable way free, exserted from the throat; anthers incumbent, bilocular, oblong, lilac; pollen of the same colour, granules large. *Pistil* single; germen small, oval; style filiform, reaching nearly to the anthers of the longest stamen; stigma 3-cleft, revolute. *Capsule* trilocular, trivalvular, loculaments monospermous, valves furrowed in the middle on the outside, and opposite to this the inner membrane projects to meet the wings of a central column, and thus complete the dissepiments. *Unripe seeds* covered with mucilaginous matter, albumen large and white, embryo central, straight, and deep green. *Ripe seeds* oblong, triquetrous, brown, inner angle acute.

The phenomenon regarding the action of the seed of the next species with water is very beautiful here also. When the dry seed is thrown on the surface of water, it for a time only partly sinks, and the vessels being liberated on the lower half only, it seems to float on a cushion of cotton. The pubescence every where upon the plant is glandular, and is particularly abundant and glutinous on the calyx.

This is a very pretty plant, and being cultivated with the greatest ease, ripening abundance of seed, it very well deserves a place among hardy annuals. The seeds were collected by Mr Douglas on the NW. coast of America, and were presented to us by Mr Sabine. The plants flowered in the Royal Botanic Garden in July and August.

Collomia linearis.

C. *linearis;* integerrimis, reflexis, superioribus ovato-acuminatis, utrinque pubescentibus, inferioribus lineare lanceolatis, glabriusculis; floribus capitatis; caule ramoso, pubescente.

Collomia linearis, *Nuttall*, Gen. of N. American Plants, i. 126.—*Bot. Reg.* t. 1166.

Description.—*Root* annual. *Stem* somewhat woody, branched above, pubescent, grooved. *Branches* axillary, spreading, pubescent. *Leaves* scattered, sessile, entire, recurved, the lower linear-lanceolate, subglabrous, the upper pubescent on both sides, ovato-acuminate, crowded near the top of the stem. *Flowers* capitate, on very short, terminal pedicels, closely surrounded by the leaves, viscid. *Calyx* persisting, 5-cleft, hairy, with 5 projecting angles, funnel-shaped; segments 3-nerved, ovate, acute, connivent green and thickened at their apices. *Corolla* inferior, funnel-shaped, with a long, slender, linear, yellow tube, inflated at the base, and slightly at the faux, 5-cleft, two or three times longer than the calyx; segments obtuse, rose coloured, spreading. *Stamens* 5; filaments slender, unequally adhering to the tube; anthers oblong, small, bilocular, incumbent, projecting into the faux. *Germen* small, oblong, deep green, surrounded at its base by a paler, somewhat membranous, cup-shaped disk, of 5 rounded lobes. *Style* filiform, equal to the tube of the corolla. *Stigma* 3-cleft, exserted, revolute and hairy above. *Capsule* shorter than the calyx, trilocular, trivalvular, 3-seeded, valves obcordate, externally channelled in the centre. *Seeds* oblong, covered with a mucous coat; albumen large and white; embryo central, straight, dark green. *Dissepiments* formed by projections from the middle of the valves meeting the 3-winged columnar receptacle of the seeds.

Phlox linearis, *Cavanilles*, Icones, 6. p. 17. t. 527. is quoted doubtfully as a synonyme for this plant. It seems, however, to be another species of the genus, distinguished especially by its smaller capitulæ, and more linear, less crowded, suberect leaves.

The seeds of this plant were received from Dr Richardson on his return from his second journey to the arctic coast of America. It bears cultivation easily as an annual, but can scarcely be esteemed for beauty. The chief interest it can excite is in the structure of its seed, and the remarkable cause, observed by Mr Lindley, of a phenomenon they present when thrown into water. In these circumstances, the mucus which envelopes them "instantly dilates and forms around them like a cloud, and in a short time acquires a volume greater than the seed itself. Upon examining the cause of this singular phenomenon, it will be found to depend upon the presence of an infinite multitude of exceedingly delicate and minute spiral vessels, lying coiled up, spire within spire, on the outside of the testa. This observation," adds Mr Lindley, "is particularly interesting, inasmuch as spiral vessels are, we believe, now for the first time seen upon the external surface of a vegetable organ."

Crotalaria angulosa.

C. *angulosa;* sublignosa, erecta, ramis patulis, acutangulis, flexuosis, adpresse pilosis, racemis oppositifoliis terminalibusque, foliis petiolatis, ovatis, obtusis, mucronulatis, stipulis lunatis reflexis, petiolo longioribus.

Crotalaria, foliis solitariis, ovato-acutis, caule sulcato, *Burm.* Zeyl. 81. t. 34.

Pee-tandalé-cotti, *Rheede*, Malab. pars 9. p. 53. t. 29.

Crotalaria verrucosa, *Linn.* Sp. Pl. 2. p. 1005.—*Willd.* Sp. Pl. 3. p. 977. *Spreng.* Syst. Veget. 3. p. 237.

Crotalaria cœrulea, *Jacq.* Icones Pl. rarior.

Crotalaria angulosa, *Lam.* Encyclop. Method. 2. p. 197.—*Cavanilles*, Icon. 4. p. 10. t. 321.

Description.—*Root* annual. *Stem* erect, round, somewhat woody. *Branches* spreading wide, acute-angled, green or purplish, hairy, hairs adpressed. *Leaves* simple (1 to 3 inches long, ¾ to 2 inches broad), bright green, paler behind, alternate, distichous, petioled, ovate, entire on their edges, blunt or retuse, mucronulate, somewhat concave, slightly undulate, especially when young, thick, soft, hairy, hairs adpressed, and by far most numerous and most conspicuous behind, middle rib strong, and as well as the oblique branched veins, channelled, in front, and very prominent behind; petioles (2–3 lines long), compressed laterally. *Stipules* broadly lunate, acuminate, reflexed, persisting, smaller upwards, same colour and texture as the leaves. *Racemes* terminal, or opposite to the leaves, many-flowered; common footstalk resembling the branches, without flowers for about half its length; pedicels (3 lines long) drooping, round, slightly swollen towards the flowers, purplish, hairy, hairs white, shining, adpressed; bracteæ small, subulate, one under the origin of the pedicel, half its length, two, very minute but otherwise similar, subopposite, nearly half way up the pedicel. *Calyx* with few adpressed hairs, 5-parted, segments pointed, the two upper spread wide upon the back of the vexillum, the three others frequently adhering at their apices. *Corolla* pale lilac, streaked with darker lines deepest at their origin, marcescent; vexillum more than twice the length of the calyx, broad, reflected, retuse, keeled towards its apex, pale behind; alæ blunt, spreading below, shorter than the vexillum; carina pointed, rather shorter than the alæ, greenish. *Filaments* 10, 5 longer than the others, pubescent, free for about half their length, tube cleft above, ribbed. *Anthers* orange-yellow, bursting along their sides, on the longer filaments small, round, on the shorter, large, cordato-oblong, broadly furrowed between the lobes; pollen very abundant, orange-yellow. *Germen* woolly, equal to the filamental tube. *Style* longer than the stamens, bent to a smaller angle as the germen lengthens, and then its knee is thrust through the carina, hairy on the upper side for two-thirds of its length, persisting and laid along the upper suture of the pod. *Stigma* ovate, flattened, blunt, oblique. *Pod* inflated, oblong, compressed above and below, widely channelled along the upper suture, broadest towards the style, pendant, sprinkled with adpressed hairs. *Seeds* when unripe kidney-shaped, flattened.

The specific name of Linnæus is singularly inapplicable. In the smooth, starched, bad figure of Cavanilles, the angles are not sufficiently sharp, and the stipulæ are by much too narrow: in Rheede's figure, the edges of the leaves are too much crisped, the stipulæ not sufficiently lunated, are waved instead of being flat, the angles of the branches are ill-defined, and the legumes far too spreading.

Rheede adds to many fancied medical properties of this plant, that its root, when bruised and applied to the eyes, has the power of restoring and strengthening the memory.

We received the seeds of this plant, with others from India, from Mr Curtis, in July 1827. It has flowered in the stove of the Royal Botanic Garden in July and August.

Eutoca Franklinii.

E. *Franklinii;* erecta, foliis pinnatifidis pilosis, petiolatis, laciniis lanceolato-ellipticis, integris incisisve, spicis confertis, secundis, deflexis, ovulis placentæ singulæ viginti pluribus.

Eutoca Franklinii, *R. Brown*, in Botanical Appendix to Captain Franklin's Narrative of the First Journey to the Arctic Sea, with a figure.

Description.—*Root* perennial? *Stem* herbaceous, with us 7 inches high, round, slightly flexuose, occasionally branched, green, pubescent, hairs rather harsh and spreading. *Root-leaves* (nearly 2 inches long) numerous, green on both sides, but paler below, suberect, lanceolate, pinnatifid, petioled, thick, covered with pubescence shorter and less harsh than that on the stem, segments varying in shape, lanceolate or oblong, entire or incised, especially on their lower edge, alternate or opposite, channelled in front, and each with a central rib, prominent behind, but without veins; petiole half the length of the leaf, channelled. *Stem leaves* scattered, similar to the others, but on shorter petioles, half embracing the stem, smaller, the segments more pointed, less frequently incised, and the lower generally the longest. *Spikes* crowded towards the top of the stem, terminal or axillary, many-flowered, recurved, flowers secund. *Calyx* green, persisting, 5-parted, segments linear-awl-shaped, flat, obscurely 3-nerved, hairy, strongly ciliated, loosely applied to the corolla, and subsequently to the capsule. *Corolla* inferior, longer than the calyx, campanulate, 5-cleft, white for half its length, and above this of uniform lilac, pubescent on the outside of the limb, every where else glabrous, but slightly wrinkled, from the branching of obscure veins; segments of the limb equal, rounded, spreading; tube with ten longitudinal projecting membranes, connivent along their inner edges in pairs which alternate with the stamens. *Stamens* 5; filaments arising from the base of the corolla, and falling with it, alternating with the segments, scarcely exserted, colourless, filiform, slightly flattened at the base, sparingly covered with long lax hairs; anthers incumbent, oblong, orange-yellow, bilocular, loculaments bursting along their sides; pollen whitish. *Pistil* single, at first rather shorter than the stamens, afterwards longer than them; germen ovate, less than half the length of the calyx, green, covered with long erect white hairs, surrounded by a white zig-zag disk; style filiform, slightly flattened, marcescent, divided to above a quarter of its length, segments diverging; stigmata small, rounded. *Capsule* ovate, acuminate, rather longer than the calyx, somewhat compressed, uneven from elevations occasioned by the seeds, and distinctly marked by a suture along each side, unilocular, bivalvular, bursting from the apex, their pointed extremities diverging receptacle of the seeds along the middle of each, and projecting into the loculament. *Seeds* numerous upon each receptacle, dark drown, ovate, dotted, trigonous, acutely angled on their belly, flat, or slightly convex on their sides.

This pretty plant has been raised in a cold frame in the Botanic Garden, Edinburgh, from seeds presented by Dr Richardson. The species grows abundantly between Lat. 54° and 64° N. among trees that have been destroyed by fire.

Geranium Carolinianum.

G. *Carolinianum;* caule procumbente, tereti, dichotomo, ubique pubescente; foliis pilosiusculis, tripartitis, inciso-pinnatifidis, laciniis mucronulatis, basi cuneatis, lateralibus bifidis; pedunculis sparsis bifloris, pedicellos æquantibus; petalis obcordatis, vix calycem pilosum mucronatum superantibus.

Geranium columbinum Carolinum, capsulis nigris hirsutis, *Dillen.* Hort. Eltham, t. 135.

Geranium pedunculis bifloris, foliis multifidis pericarpiis hirsutis, *Gronov.* Fl. Virgin. p. 101.

Geranium Carolinianum, *Linn.* Sp. Pl. vol. ii. p. 956.—*Cavanilles,* Dissert. iv. p. 206. t. 124. f. 2. and t. 84. f. 1. ?—*Willd.* Sp. Pl. vol. iii. p. 711. —*Mill.* Dict. ed. 1807, No. 30.—*Pursh,* 2. p. 449.

Geranium Carolinianum? No. 264. *Richardson's* Botanical Appendix to Captain Franklin's Narrative of his first Journey to the Polar Sea.

Description.—*Root* annual. *Stem* procumbent, round, hairy, spreading, dichotomous, flexuose, swelling at the joints, green or reddish. *Leaves* (about 2 inches across) green, but red when fading, opposite, petiolate, reniform, tripartite, inciso-pinnatifid, two side lobes bipartite, segments mucronate, veined, hairy on both sides, the hairs being soft, longer and more distinct on the back of the veins; petioles (2 inches long), round, hairy, spreading wide or divaricated; *stipules* awl-shaped, strongly ciliated and hairy, one on each side of the petiole. *Peduncles* (1 inch long) 2-flowered, in the bifurcations of the stem below, but in the axils of the leaves above, round, covered with soft glandular hairs. *Pedicels* unequal, as long as the peduncles, and resembling them, curved upwards, enlarging near the calyx. *Bracteæ* 4, at the bifurcation of the peduncle, similar to the stipules. *Flower-buds* nodding; *flowers* nearly erect. *Calyx* hairy on the outside, but glabrous within, segments 3-ribbed, flattish or slightly concave externally, mucronate, mucro blunt and hairy. *Corolla* rose-coloured, petals obcordate, veined, rather longer than the calyx; *anthers* lilac, subrotund; *filaments* flat, smooth, tapering towards the apex, where they are spreading. *Capsules* hairy, slightly wrinkled transversely, at first green, afterwards dark leaden coloured, hairs long, coarse, spreading, of the same colour as the capsules; beaks green, when ripening approaching the colour of the capsules, equal to two-thirds the length of the style, covered with soft, short, glandular pubescence. *Style* hairy, green. *Stigmata* 5, glandular, red, at first revolute and afterwards erect. *Seeds* dotted, oblong, black.

I have ascertained this to be Dr Richardson's plant, by comparison with a specimen presented by him to Professor Jameson, after his return from his first journey. I think there is no doubt that it is the plant figured by Cavanilles at t. 124. If t. 84. be the same, it is a young plant, which had not acquired its characteristic habit. There seems nearly as little doubt of the identity of the plant figured by Dillenius; but the descriptions of the other authors quoted, and several others which might have been mentioned, are so imperfect, that my chief reliance on them arises from their having referred to the figure of Dillenius. Jacquin, Hort. Schœnbr. referred to in Hort. Kew. I have not an opportunity of consulting.

We received the seeds at the Botanic Garden from Dr Richardson on his return from his second journey, and have treated the plant as a hardy annual.

Liparis Correana.

L. *Correana;* foliis binis, ovato-oblongis; scapo angulato; floribus spicatis; sepalis margine revolutis, inferioribus contortis; labello lineari-spathulato, sepalis breviori, medio recurvo, apice cordato.

Malaxis Correana, *Bart.* Prodr. Flor. Philadelph. p. 86.—*Nuttall,* Genera of N. American Plants, v. ii. p. 196.

Malaxis longifolia, *Bart.* Flora of N. America, t. 75.

Liparis Correana, *Sprengel,* Syst. Veget. v. iii. p. 740.

Description.—*Root* bulbous. *Stem* erect, various in height (about 7 inches), (5 ?)-angled, winged. *Leaves* opposite, at the base of the stem, sometimes shorter sometimes longer than it, erect, elliptico-lanceolate, sharply keeled behind, obscurely nerved, especially in front. *Spike* many-flowered, bracteate; bracteæ single, at the base of each flower, pointed. *Perianth* 5-cleft, three outer segments linear, revolute, in their edges, the upper erect, two lower parallel, projecting forwards, twisted; the two inner filiform, spreading, and finally reflected: *Labellum* shorter than the perianth, linear-spathulate, channelled, bent in the middle towards the lower segments of the perianth, notched at its extremity, with a point in the notch. *Column* erect, winged above, contracted in its middle, half as long as the labellum. *Anther-case* terminal, keeled above, 2-celled; cells round, with white, membranous edges. *Pollen-masses* 2, one in each cell, ovate, sessile, bright yellow. *Stigma* rounded, white, projecting under the pollen-masses. *Germen* short, partly superior, angled, clavate, winged, afterwards enlarging very greatly, but retaining the same form, wings crenate. Whole plant, except the pollen-masses, of uniform green.

This plant was introduced into the collection of Mr Cunninghame at Comely Bank, near Edinburgh, in 1826, by Mr Blair, who found it growing in Upper Canada. It bears cultivation well, has been kept by Mr Cunninghame in pots with peat soil, in the stove, and flowered very abundantly in June 1828. It flowered in the open air at the Royal Botanic Garden in the same month. We owe the plant to the Countess of Dalhousie, who introduced it from Canada. Dr Barton appears first to have discovered the species in rich soil, under damp shady woods, along the banks of the Schuylkill, near Philadelphia, in 1815. It has probably, therefore, a pretty wide range in North America, though not mentioned by any American botanist except the two I have quoted. Its period of flowering in Pennsylvania is precisely the same (June) as in cultivation with us, either in the stove, or exposed to the open air. It has neither size nor colour to make it attractive.

The great resemblance between this plant and *Liparis Loeselii* of Europe, caused them to be considered the same in America, but Dr Barton very properly points out the distinction in the triangular stem of *L. Loeselii*, and the different direction of the perianth; and I may add, that depending on the lip being entire, and longer than the perianth in the European species. The comparative length of the scape and leaves varies so much that it deserves no attention.

Petunia acuminata.

P. acuminata; foliis ovato-acuminatis, subsinuatis, tubo corollæ limbum quadruplo superante.

Description.—*Stem* herbaceous, erect, round, branched, as well as the branches covered with short, colourless, inconspicuous, soft hairs. *Leaves* (4 inches long, 1½ broad) scattered, petioled, ovate, acuminate, subsinuate, flat or very slightly undulate, erect harsh pubescence diffused over their upper surface, but below chiefly confined to the middle rib and veins; between these the pubescence is much softer, and less conspicuous. Middle rib and veins very prominent below, petiole (about 1½ inch long) very slightly bordered by the decurrent leaf, flat on its upper surface, round on the lower. *Peduncle* (¾th inch long) solitary, single-flowered, round, subopposite to the leaves, erect. *Calyx* (¾th inch long) 5-parted, unequal, linear, blunt, subappressed, segments keeled, and connected to about their middle by a colourless membrane. *Corolla* white, striated with green; tube (2 inches long) cylindrical, with 5 pits rather under its middle, and below this somewhat contracted; limb (1¼ inch across) about a fourth part of the length of the tube, 5-cleft, lobes blunt, slightly emarginate, plicate, with a dark green branched line along the middle of each externally. *Stamens* unequal, two longer subexserted, three others included; filaments arising from the base of the corolla, flat, hairy, and adhering to the tube as far as the pits, above which they are free, filamentous, and smooth, except for a little way at the bottom, inserted into the back of the anthers, which are short, smooth, oval, bilobular, green, bursting laterally, after which they are reflected, and become brown; pollen nearly white. *Germen* bilocular, green, conical, tetravalvular, surrounded at its base by a glabrous, shining, tumid disk, of a deep orange colour, sutures marked by a deep green line. *Style* filiform, equal in length to the shortest stamen. *Stigma* deep green, cleft, segments short, blunt, revolute. *Ovules* very numerous, fixed to a central receptacle, whose transverse section is kidney-shaped in each loculament. The whole plant, excluding only the pistil, the upper part of the stamens, and the inside of the corolla, is covered with a glutinous pubescence, which is most harsh and least glutinous upon the leaves.

The plant was raised in the Royal Botanic Garden, Edinburgh, in 1828, from seed transmitted to us from Mendoza by Dr Gillies. It will no doubt attain a much larger size with more pot room, or in the open border; but with us, in a small pot in the greenhouse, does not exceed two feet. Has flowered freely in July, and promises to ripen seed.

Podolepis gracilis.

P. *gracilis;* herba erecta gracilis ramosa, foliis sparsis, integerrimis, glabris, inferioribus ovato-oblongis, superioribus ovato-acuminatis.

Description.—*Root* descending, tapering, having short, lateral, branching fibres, annual. *Stem* erect, slender, very slightly compressed, smooth and shining, slightly flexuose, branched; branches suberect, resembling the stem. *Leaves* 3-nerved, central nerve keeled behind, glabrous, shining, somewhat succulent, quite entire, sessile and stem clasping, the lower (3½ inches long, ¾th of an inch broad) ovato-oblong, with a short central point, the upper ovato-acuminate, and gradually becoming smaller towards the flowers. *Flowers* radiate, terminal or axillary. *Peduncles* (3–4 inches) long, filiform, and resembling the branches, which, indeed, they should perhaps be considered, as they have distantly scattered along them abortive flower-buds, each covered with an inconspicuous leaf resembling a bractea. *Anthodium* ovate, imbricated, dry, membranous, shining, greenish, when withered pale brown; scales ovate, entire, having a distinct middle rib occasionally projecting at the apex in form of a little mucro, on rough footstalks, in the inner scales as long as themselves, but shorter in the outer, which are loose, and extended a little way on the peduncle. *Receptacle* naked, tubercled. *Florets* of the disk (nearly ¾ths of an inch long) hermaphrodite, rose-coloured, especially at their apices, divaricated, and projecting outwards between the tubes of the ray, regular, 5-cleft, segments spreading. *Anther-tube* included, bursting at its apex, and discharging white pollen; *filaments* nearly as long as the anthers, inserted into the corolla above the middle of the tube. *Ray* at first rose coloured, but soon fading to white, spreading, (1¼ inch across,) corollulæ ligulate; tube (⅜ths of an inch long) filiform; limb equal in length to the tube, linear-oblong, cordate at the apex, bi-nerved. *Seeds* small, leaden coloured, lanceolate-oblong, dotted, slightly tomentose, having at the base an umbilicus, which is circular, white, slightly excavated, with prominent edges; many abortive. *Pappus* simple, rough, nearly equal, half the length of the tube of the ray, two-thirds of that of the disk.

The seeds of this plant were sent to us from New South Wales in November last by Mr Fraser, as a species of *Centaurea.* The plants have been kept in the greenhouse of the Royal Botanic Garden, and will produce very few seeds.

Sisymbrium brachycarpon.

S. *brachycarpon;* caule erecti, simplici, foliisque glanduloso pubescente; foliis sessilibus, lyrato-pinnatis, foliolis profunde pinnatifidis; pedicellis patentibus, vix siliquam suberectam, glabram, subclavatam, æquantibus; petalis calycem superantibus.

Sisymbrium brachycarpon, No. 260. *Richardson*, Bot. Append. to Franklin's Narrative of First Journey.

Description.—*Root* fibrous, annual. *Stem* erect, slender, simple as raised from seed in a pot, and crowded, (native specimen from Dr Richardson branched,) a foot high, leafy. *Leaves* erect, nearly glabrous, lyrato-pinnate, pinnæ on the lower deeply incised, somewhat blunt, on the upper linear, scarcely toothed, channelled. *Flowers* very small, in terminal corymbs, but rachis gradually elongating (to 3 inches), and, as well as the upper part of the stem, slightly flexuose. *Corolla* yellow, petals longer than the calyx. *Style* very short. *Stigma* bilobular, subcapitate. *Pedicels* of the fruit elongated (to about 4 lines), spreading. *Silique* rather longer than the pedicel, uneven from the seeds within. *Seeds* ovate, suspended by slender stalks.

The plant was raised in a cold frame at the Royal Botanic Garden, Edinburgh, from seeds collected by Dr Richardson in his last arctic journey, and flowered in June.

Sisymbrium canescens ?

S. *canescens* ? caule terete, ramoso, erecto, foliisque pinnatis subpubescentibus, pilis adpressis, foliolis lanceolatis, serrato-incisis; floribus corymbosis, racemis fructus elongatis; siliquis suberectis, ellipticis, pedicello longioribus, petalis calycem vix superantibus.

Sisymbrium canescens, *Richardson's* Bot. App. to Franklin's Narrative of First Journey.—*De Cand.* Syst. 2. p. 474. ?—*Nuttall*, Gen. of N. Amer. Plants, 2. p. 68. ?

Description.—Annual. *Stem* erect, round. *Leaves* pinnated, leaflets serrato-incised, elliptico-lanceolate. *Flowers* corymbose, small. *Calyx* subhispid, concave, nearly as long as the corolla. *Petals* yellow, entire, limb rounded, equal in length to the claw. *Filaments* slender, rather longer than the calyx; anthers small. *Stigma* large, its lobes diverging. *Style* distinct, though short. *Siliques* in racemes, longer than the pedicels, elliptical, smooth, obscurely winged along the back of the valves. *Seeds* oblong, brown, about 14 in each silique. Whole plant to the base of the siliques of a glaucous appearance, from a close, dense, short, soft tomentum. Lower part of the stem purple.

The plant was raised at the Royal Botanic Garden from the same collection of seeds, and under the same treatment as the last species. It produced its flowers in May. The seeds were only marked with the generic name by Dr Richardson, but the species seems the same with that given by him to Professor Jameson under the name I have adopted. I cannot, however, persuade myself that it is the same with the plant of Nuttall, or De Candolle. The different comparative length of the pedicels and siliques, which never varies in our specimens, and other marks, seem to keep them distinct.

Trachymene cœrulea.

T. *cœrulea;* herbacea, foliis palmatis, tripartitis, laciniis incisis, mucronatis; umbella simplici; petala obovata-subrotunda, stamina æquantia.

Description.—Annual. *Seminal leaves*, carried two inches above ground, and bearing upon their summits the tunic of the seed, elliptical, glabrous, green on their upper, deep purple on their lower side. *Herb* erect, and on every part, even to the outer surface of the petals, covered with spreading, unequal, glandular pubescence, from which exudes a subviscid juice. *Stem* round, erect, branching, green. *Leaves* alternate, those from the root supported on petioles about as long as themselves, palmate, 3-parted, the lateral portions cleft, and all the segments incised and mucronate, the stem leaves more entire and more sessile upwards. *Umbels* terminal or axillary towards the top of the stem, on very long peduncles (about 7 inches), simple, many-rayed, flattish (above 2 inches across). *Involucre* many-leaved, (⅜ths of an inch long,) linear-awl-shaped, mucronate, and strongly ciliated, reflected along the peduncle while the flowers are expanded, brown. *Rays* white, filiform-subulate, unequal, the outer in general nearly twice the length of the involucre, and always more than twice as long as those in the centre, spreading or divaricated, and after flowering erect, bending across each other, collected as in the bud, and invested by the involucre, which also becomes erect. *Flowers* handsome, many of them abortive, (always so in the ray?) *Calyx* obsolete, segments minute points on the outside of the filaments, and alternate with the petals. *Corolla* lilac; petals 5, nearly equal, spreading, obovato-subrotund, entire, undulate, glabrous on their inner surface, paler on their outer, veins obscure. *Stamens* 5; filaments erect, equal to the petals; anthers bilocular, oval, incumbent, white, marked while in the bud by a purple line along their edges, at which place they afterwards burst; pollen white. *Germen* inferior, cordato-kidney-shaped, flat, the commissure of the seeds being in the shortest diameter, rugolose, pubescent, crowned by a thin, colourless, spreading, entire, flat, membranous border above the insertion of the petals, each lobe marked towards its inner edge by a crescent-shaped rib, so that the two together inclose an ovate space, extending from the base to the apex of the fruit. *Styles* 2, diverging, shorter than the filaments. *Stigmata* capitate. *Fruit* when ripe brown, undulate, verrucose, seed considerably narrower than its covering.

We received the seeds of this unusually beautiful umbelliferous plant from Mr Fraser, colonial botanist, New South Wales, in November 1827, under the generic name Brunonia. They were marked "native of the Island of Baracha."

The plants were raised in a cold frame, and have been in flower in the Botanic Garden during August. They appear to belong to the genus *Trachymene* of Rudge, but the root-leaves of the species figured by him are more divided, and on much longer petioles than in any of our specimens; his plant is much smaller, the rays of the umbel much shorter, the petals of a very different shape, and shorter than the stamens, and, above all, the fruit is said to be subglobular, instead of flat, as with us. Yet the habit is so much alike, that a fear of multiplying names, without a certainty of a difference of species, had led me to adopt his specific name with doubt, while I at the same time pointed out the above distinctions, and thought it difficult to suppose that so very beautiful a flower should have been so long overlooked, if it grows, as he states his to have done, near Port Jackson. On showing the proof-sheet, however, to M. Alphonse De Candole, I was informed by him, that his father considers it certainly distinct, and will call it *T. cœrulea*. Such authority confirmed my own doubts, and I willingly adopted this designation. I have since heard from Dr Hooker that he too *suspects* Rudge's plant may be distinct from ours.

Villarsia lacunosa?

V. *lacunosa;* acaulis, foliis coriaceis, ovato-reniformibus, subpeltatis, crenatis, subtus concavis maculato-punctatis obsolete venosis, petiolis radicantibus floriferis, floribus fasciculatis, corollis lateribus glabris apicibus obtusis, crenulatis, calycibus acutis.

Villarsia lacunosa, *Vent.* Choix. p. 9.?

Villarsia aquatica, *Gmel.* Syst. Veg. 1. p. 447.?—*Rœm. & Sch.* 4. p. 180.?

Menyanthes trachysperma, *Mich.* Fl. Bor. Amer. 1. p. 126.?

Description.—Without *stem*. *Leaves* all radical, floating, ovate, deeply cloven at the base, lobes little separated, crenated, subpeltate, upper surface slightly convex, bright green, veinless, lower slightly concave, paler, obscurely marked with broad flattened veins, and many irregular red spots, and innumerable points of the same colour; petiole round, greatly elongated (1–2 feet), about half an inch below the leaf bearing a fasciculus of flowers, and a cluster of slender, rigid, conical *tubers*, from which proceed other petioles, bearing flowers and roots in the same manner, and these again others, in endless succession. These tubers frequently become black, and decay, in which case another cluster is produced in contact with them. *Pedicels* single-flowered, bent so as to carry the flowers above water, but after this is passed, straight or curved downwards. *Calyx* 5-partite, acute, spreading, green and dotted sparsely with red, persisting, and then closed, and segments approximating at the apices. *Corolla* pure white, rotate, 5-parted, segments obovate, slightly notched, and crenulate at the apices, divided longitudinally into three nearly equal parts, of which the two lateral are transparent, undulated and glabrous, the centre elevated, more opaque, bearded in longitudinal lines at the apex, and more slightly so at the base; throat yellow, glandular, the glands yellow, alternate with the stamens, stipitate, shaggy, granular. *Stamens* 5, yellow; filaments as long as the germen, awl-shaped, arising from the base of the corolla, and adhering to it throughout the whole length of the short tube, above which they are connivent; anthers cordate, bursting along their edges; pollen deep yellow. *Germen* green, ovate, slightly compressed, crowned by the bifid stigma, unilocular. *Ovules* obovate, about 20, attached to the inside of the germen on each side at the sutures, which are obscurely marked within, and invisible on the outside of the germen.

This very pretty little aquatic was found by Mr Blair in lakes in Upper Canada, and introduced by him into Mr Cunninghame's garden in 1826. It is no doubt quite hardy, but, from the difficulty of preventing it from floating about, and being accidentally removed with the weeds in cleaning the pond, it has been kept in the Botanic Garden in a tub which stands in the stove, and there flowers very freely during a great part of summer.

I have considerable doubt about the correctness of the specific name and the synonyms quoted; but not at present having an opportunity of consulting Ventenat, I think it right to adopt his name till I have. The genus *Villarsia* is probably naturally distinct from *Menyanthes*, but this species shows that the essential generic character requires revision.

◆

NOTE.—In the last Number of this Journal, I described, under the name of *Cattleya intermedia*, a beautiful plant which flowered at the Botanic Garden, and an admirable and most correct figure of the specimen has appeared under the same name in the Botanical Magazine, t. 2851., the thin, grey, membranous sheath of the stem only having been neglected in the colouring. I pointed out its near affinity to *C. Forbesii* (Bot. Reg. t. 953.), but considered it certainly distinct, especially on account of the very different appearance of the spathe. Subsequently, however, I began to doubt whether I was right, for a specimen flowered with us having the colour, and in some other respects the appearance, of *C. Forbesii*, still, however, retaining the spathe of *C. intermedia*. Within these few days, I have seen in the possession of Mr Neill a specimen of *C. Forbesii* from the Chiswick Garden. It has the spathe of our plant; and as I consider it authority for ascertaining the species of Mr Lindley's, I must believe the figure in Botanical Register faulty, or the plant liable to great variation, and therefore I take the earliest opportunity to state my belief, that ours is only a beautiful variety of the same.

The original specimen has again flowered with us. It retained all its splendid colouring, and produced two flowers, with one or more abortive buds, so that probably it may yet assume a much more magnificent appearance. Is there not some reason to fear, that, in this splendid genus, forms vary very considerably, and that this may not be the only instance in which species and varieties have been confounded?

Celestial Phenomena from October 1. 1828 *to January* 1. 1829, *calculated for the Meridian of Edinburgh, Mean Time.*

By Mr George Innes, Aberdeen.

The times are inserted according to the Civil reckoning, the day beginning at midnight. —The Conjunctions of the Moon with the Stars are given in *Right Ascension.*

OCTOBER.

D.	H.	′	″	
3.	15	9	56	☌ ☽ 1 α ♋
3.	16	16	56	☌ ☽ 2 α ♋
4.	13	50	6	☌ ☽ ο ♌
4.	21	1	9	☌ ☽ ♀
5.	0	0	2	☌ ☽ π ♌
5.	18	29	37	☌ ♂ b ♐
5.	23	35	41	☌ ♀ π ♌
7.				♀ greatest elong.
7.	3	12	56	☌ ☽ υ ♌
7.	12	42	38	☌ ♀ α ♌
8.	23	52	43	● New Moon.
10.	11	17	25	☌ ☽ λ ♍
10.	19	45	38	☌ ☽ ☿
11.	10	16	17	☌ ☽ ♃
11.	19	37	51	Im. III. sat. ♃
11.	20	33	18	☌ ☽ 4 ζ ♎
12.	5	27	25	☌ ☽ ϑ ♎
12.	21	22	41	☌ ☽ φ Oph.
13.	17	14	41	☌ ♀ ρ ♌
16.	6	19	57	☽ First Quarter.
16.	15	46	33	☌ ☽ ♅
16.	19	33	47	☌ ☽ ♂
16.	21	13	29	☌ ☽ β ♑
18.	7	32	34	☌ ☿ ♃
18.	22	13	37	☌ ☽ ϑ ♒
18.	23	36	50	Im. III. sat. ♃
22.	0	5	27	☌ ☽ ε ♓
22.	4	3	27	☌ ☽ ζ ♓
22.	17	34	6	☌ ☽ ο ♓
23.				☿ greatest elong.
23.	0	44	5	○ Full Moon.
23.	10	6	2	☉ enters ♏
25.	13	12	17	☌ ♀ σ ♌
25.	14	29	25	☌ ☽ 1 δ ♉
25.	14	58	31	☌ ☽ 2 δ ♉
27.	4	28	20	☌ ♀ τ ♌
30.	9	43	39	☌ ☽ ♄
30.	16	5	30	☾ Last Quarter.
30.	23	2	59	☌ ☽ 1 α ♋
31.	0	9	53	☌ ☽ 2 α ♋
31.	21	43	56	☌ ☽ ο ♌

NOVEMBER.

D.	H.	′	″	
1.	7	55	36	☌ ☽ π ♌
1.	13	50	43	☌ ♀ β ♍
2.	2	49	21	☌ ♂ ϑ ♑
3.	11	14	58	☌ ☽ υ ♌
3.	19	44	19	☌ ☽ ♀
6.	19	3	4	☌ ☽ λ ♍
7.	14	34	38	● New Moon.
8.	3	44	7	☌ ☽ 4 ζ ♎
8.	11	36	16	♀ very near η ♍
8.	19	50	–	☌ ☽ ☿
8.	12	27	1	☌ ☽ ϑ ♎
9.	4	26	46	☌ ☽ ♃
11.	4	16	51	☌ ♃ γ ♎
12.	20	12	38	☌ ☽ ♅
12.	22	42	–	☌ ☿ ♃
13.	2	34	15	☌ ☽ β ♑
13.	13	37	54	☌ ♀ γ ♍
13.	20	33	–	Inf. ☌ ☉ ☿
14.	8	6	37	☌ ☽ ♂
14.	13	20	26	☽ First Quarter.
15.	2	36	5	☌ ♂ γ ♑
15.	4	8	48	☌ ☽ ϑ ♒
17.	8	15	–	☌ ☉ ♃
17.	18	32	46	☌ ♂ δ ♑
17.	22	27	49	☌ ♃ χ ♎
18.	7	48	56	☌ ☽ ε ♓
18.	12	3	18	☌ ☽ ζ ♓
19.	1	51	39	☌ ☽ ο ♓
20.	0	31	49	☌ ♀ ϑ ♍
21.	14	13	25	○ Full Moon.
21.	23	39	44	☌ ☽ 1 δ ♉
22.	0	8	50	☌ ☽ 2 δ ♉
22.	6	29	10	☉ enters ♐
23.	10	36	13	☌ ♀ α ♍
26.	18	15	18	☌ ☽ ♄
27.	7	15	21	☌ ☽ 1 α ♋
27.	8	22	3	☌ ☽ 2 α ♋
28.	0	43	24	☌ ☽ ξ ♌
28.	5	55	25	☌ ☽ ο ♌
28.	16	8	24	☌ ☽ π ♌
29.	13	20	6	☾ Last Quarter.
30.	8	48	29	☌ ♃ λ ♎
30.	19	53	0	☌ ☽ υ ♌

DECEMBER.

D.	H.	′	″	
1.				☿ greatest elong.
4.	0	34	27	☌ ☽ ♀
4.	4	26	41	☌ ☽ λ ♍
4.	17	25	–	☿ near 4 ζ ♎
5.	10	51	15	☌ ♀ λ ♍
5.	13	0	43	☌ ☽ 4 ζ ♍
5.	15	17	26	☌ ☽ ☿
5.	21	37	45	☌ ☽ ϑ ♎
6.	0	38	42	☌ ☽ ♃
7.	3	52	53	● New Moon.
9.	21	47	–	☌ ☿ ♃
10.	6	42	25	☌ ☽ ♅
10.	9	1	29	☌ ☽ β ♑
10.	17	28	–	☌ ☿ 1 β ♏
10.	17	53	–	☌ ☿ 2 β ♏
12.	9	36	37	☌ ☽ ϑ ♒
12.	23	5	12	☌ ☽ ♂
13.	0	23	13	☌ ♂ λ ♒
13.	16	57	58	☌ ♃ 1 β ♍
13.	18	18	33	☌ ♃ 2 β ♍
13.	21	21	30	☽ First Quarter.
15.	9	33	59	Em. III. sat. ♃
15.	13	34	37	☌ ☽ ι ♓
15.	17	53	8	☌ ☽ ζ ♓
16.	7	59	24	☌ ☽ ο ♓
19.	7	10	21	☌ ☽ 1 δ ♉
19.	7	39	53	☌ ☽ 2 δ ♉
20.	17	59	0	☿ ♀ 4 ζ ♎
21.	4	8	49	☌ ♃ ν ♏
21.	6	14	11	○ Full Moon.
21.	10	52	10	☌ ♂ φ ♒
21.	19	7	56	⊙ enters ♑
22.	13	32	36	Em. III. sat. ♃
22.	14	46	–	☌ ♅ β ♑
23.	23	45	22	☌ ☽ ♄
24.	15	5	29	☌ ☽ 1 α ♋
24.	16	12	41	☌ ☽ 2 α ♋
25.	8	30	15	☌ ☽ ξ ♌
25.	13	41	35	♃ ☽ ο ♌
25.	23	54	0	♃ ☽ π ♌
27.	5	21	33	☌ ♀ 1 β ♏
27.	5	37	14	☌ ♀ 2 β ♏
28.	12	50	41	♀ near ν ♏
29.	10	28	58	☾ Last Quarter.

Times of the Planets passing the Meridian.

OCTOBER.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	′	H.	′	H.	′	H.	′	H.	′	H.	′
1	12	54	8	55	18	55	14	10	7	39	19	20
5	13	0	8	55	18	49	13	59	7	25	19	5
10	13	6	8	54	18	41	13	42	7	6	18	44
15	13	12	8	56	18	34	13	26	6	48	18	25
20	13	16	8	56	18	27	13	11	6	30	18	6
25	13	16	8	57	18	20	12	55	6	11	17	46

NOVEMBER.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	′	H.	′	H.	′	H.	′	H.	′	H.	′
1	13	6	8	59	18	12	12	35	5	45	17	20
5	12	48	9	0	18	7	12	22	5	29	17	4
10	12	14	9	1	18	1	12	4	5	9	16	45
15	11	37	9	2	17	54	11	54	4	49	16	26
20	10	55	9	5	17	48	11	37	4	30	16	7
25	10	35	9	8	17	40	11	22	4	10	15	48

DECEMBER.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	′	H.	′	H.	′	H.	′	H.	′	H.	′
1	10	25	9	11	17	33	11	3	3	46	15	26
5	10	30	9	13	17	28	10	51	3	30	15	11
10	10	37	9	17	17	20	10	36	3	10	14	52
15	10	46	9	21	17	11	10	21	2	49	14	33
20	10	58	9	26	17	6	10	5	2	28	14	14
25	11	11	9	31	17	0	9	50	2	7	13	56

Proceedings of the Wernerian Natural History Society. Continued from p. 180.

1828, *April* 19.—**Robert Jameson**, Esq. President in the chair.—Count Vargas Bedemar, keeper of the mineralogical cabinet of the Crown Prince of Denmark, was elected a foreign member, and the Rev. John Gibson Macvicar, A. M. was admitted an ordinary member.

Mr Blackadder's communication on polar lights, illustrated with drawings, was laid before the meeting.

Mr Bald, mining-engineer, read a memoir on the fires that take place in collieries, and particularly on the recent fires in the collieries of Whitehill and Polton, in Mid-Lothian, and of South Sauchie, in Clackmananshire. (This important paper is printed in this Journal, *supra*, p. 101, *et seq.*)

The Secretary read a notice communicated by Mr Macgillivray, regarding a cuckoo, which had been kept in a cage since it was taken from a titlark's nest, in the end of July 1827; and the bird was communicated to the meeting. (See *supra*, p. 200.)

Mr **Falconar**, Vice-President, having taken the chair, Professor Jameson communicated a notice in regard to the opaline wood found in New South Wales, and exhibited a magnificent specimen presented to the Museum by Sir Thomas M. Brisbane, Bart.

June 21.—**David Falconar**, Esq. Vice-President, in the chair.—At this meeting his Excellency Count Platen, vice-lieutenant of Norway, and Professor S. Nillson, of the University of Lund, were elected foreign members.

The Secretary read a paper by the Rev. William Scoresby of Liverpool, entitled, Remarks on the Probability of reaching the North Pole; being an examination of the recent expedition under Captain Parry, in order to the inquiry how far that experiment affects the practicability of the enterprize. (This interesting communication is printed in this Journal, *ut supra*, p. 22, *et seq.*)

The Society then adjourned till November.

SCIENTIFIC INTELLIGENCE.

NATURAL PHILOSOPHY.

1. *Proposed Improvement of the Air-Pump.*—There is reason to think that something like Mr Watt's principle of the double stroke in the steam-engine, might be advantageously applied to the air-pump. By this means one barrel could do the work of two, which would both lessen the cost and greatly diminish friction. At first it might be supposed that, by this arrangement, the management of the valves would be rendered rather complicated; but, instead of that, they would admit of considerable simplification, by adopting another principle often employed about steam-engines, under the name of the coffer-slide valve. Suppose the barrel to be provided with a solid piston, moved by a rod passing through an air-tight collar. Let there be two holes in the side of the barrel, one adjoining each end; and let these be covered by a sliding bar furnished with four holes on its side, two being near to each end, and the whole so arranged, that two of them at a time, but taken in an alternate order, can, by a slight motion of the bar, be brought opposite the holes of the barrel, while the other two are not, and *vice versa*. Suppose two of the four holes, say the middle ones, to be the ends of two tubes which unite in one slender winding and slightly flexible tube, communicating with the receiver; and let the other two be merely perforations, which may have their exterior ends either quite open, or, to prevent any return of air into the barrel, they might be covered with slips of bladder or oiled silk. If, then, the bar be moved up and down alternately about the third of an inch, so as to have two of its holes, one of each sort, remaining over these in the barrel, while the piston moves in the one direction, and the other two remaining over those of the barrel, while the piston returns in the opposite direction, it is evident that we shall have, in this simple arrangement, all the security of four metallic valves, and a single barrel and piston doing the work of two. The obvious design of the long flexible tube is to permit the compound valve to move without any other joints. It might, indeed, remain fixed, while

the barrel itself moved a little, but this would have its inconveniences. I intend having an air-pump made on these principles, and then to give a more particular description of its several parts.
H. Meikle.

METEOROLOGY.

Prognostics of the Weather.—Red clouds in the west, at sunset, especially when they have a tint of purple, portend fine weather. The reason of which is, that the air, when dry, refracts more red or heat-making rays; and as dry air is not perfectly transparent, they are again reflected in the horizon. A coppery or yellow sunset generally foretels rain; but as an indication of wet weather approaching, nothing is more certain than the halo around the moon, which is produced by the precipitated water; and the larger the circle the nearer the clouds, and consequently the more ready to fall. The old proverb is often correct:

A rainbow in the morning is the shepherd's warning;
A rainbow at night is the shepherd's delight.

A rainbow can only occur when the clouds, containing or depositing the rain, are opposite to the sun; and in the evening the rainbow is in the east, and in the morning in the west; and as our heavy rains in this climate are usually brought by the westerly wind, a rainbow in the west indicates that the bad weather is on the road, by the wind, to us; whereas the rainbow in the east proves that the rain in these clouds is passing from us. When the swallows fly high, fine weather is to be expected or continued; but when they fly low, and close to the ground, rain is almost surely approaching*. This is explained as follows: Swallows pursue the flies and gnats, and flies and gnats usually delight in warm strata of air; and as warm air is lighter, and usually moister, than cold air, when the warm strata of our air are high, there is less chance of moisture being thrown down from them by the mixture with cold air; but when the warm and moist air is close to the surface, it is almost certain that, as the cold air flows down into it, a deposition of water will take place. When sea-gulls assemble on the land, stormy and rainy weather is almost always approaching*; the reason of which might be thought to be that these animals, sensible of a current of air approaching from the ocean, retire to the land to shelter themselves from the storm. This is not the case however. The storm is their element; and the little petrel enjoys the heaviest gale, because, living on the smaller sea-insects, he is sure to find his food in the spray of a heavy wave, and she may be seen flitting above the edge of the highest surge. The reason of this migration of gulls, and other sea-birds, to the land, is their security of finding food; and they may be observed, at this time, feeding greedily on the earth-worms and larvæ driven out of the ground by severe floods; and the fish, on which they prey in fine weather on the sea, leave the surface, and go deeper in storms. The search after food is the principal cause why animals change their places. The different tribes of the wading birds always migrate when rain is about to take place. The vulture, upon the same principle, follows armies; and there is no doubt that the augury of the ancients was a good deal founded upon the observation of the instincts of birds. There are many superstitions of the vulgar owing to the same source. For anglers, in spring, it is always unlucky to see single magpies, but two may be always regarded as a favourable omen; and the reason is, that, in cold and stormy weather, one magpie alone leaves the nest in search of food, the other remaining sitting upon the eggs or the young ones; but if two go out together, it is only when the weather is warm and mild, and favourable for fishing.—*Sir H. Davy in Salmonia.*

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* Immediately before a thunder-storm this summer, and in the intervals of the showers, swifts and martins were observed to fly very high:—and so of many other prognostics.—M.

3. *Disturbance of the Magnetic Needle by Polar Lights.*—Various natural causes act upon the magnetic needle, so as to occasion a sudden change in its position, or at least to disturb the regularity of its diurnal variations. Of all these causes, the aurora borealis appears to be the most energetic and infallible. When this meteor rises in the northern regions, the sky is resplendent with light; and during its whole continuance, which sometimes lasts for ten or twelve hours, the magnetic needle experiences a continued agitation, and a considerable deviation. The *summit* of the arch of the aurora is in general in the mag-

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* Gulls generally betake themselves to the land, not before, but after storms.—M.

netic meridian, and its *crown*, that is to say, the focus toward which the rays of flame, which seem to proceed from the horizon, or from the arch itself, dart, always occurs nearly in the prolongation of the inclination of the needle. The compass is not only agitated in the places where the aurora is visible, but also at great distances, at Paris and Wilna, for example, even when there are no traces of the meteor to be perceived in the sky. But, in general, the agitation is greater the nearer the phenomenon is, and the greater intensity it displays. Thus we are told that the compass of the Paris Observatory often experiences, in the day or in the night, a sudden deviation, which occasionally extends to one degree, without any apparent cause being discoverable; and it is afterwards learned that the compasses of London and Petersburgh have at the same time experienced similar motions, and that in the northern countries some brilliant aurora has been observed. An observer in his cabinet, says Pouillet, is therefore apprized by his compass, of what is taking place in the polar regions, just as he learns, from his barometer, what is taking place in the higher regions of the atmosphere.

4. *Effects of Rarified Air of Mountains on the Pulse.*—Dr Brunner of Berne, read last year to the Helvetic Society of Natural Sciences, the second part of the account of his journey to Etna, in the year 1826, in which, after describing the mountain, and speaking of its volcanic phenomena, he entered into minute details respecting the limits of the snow upon it, the circumstances of which he did not well know how to explain. He then spoke particularly of the phenomenon of the acceleration of the pulse, and of the changes in the beatings of the pulse, produced by ascending high mountains. He mentioned the more remarkable examples of the two phenomena, and related what he had occasion to observe himself with respect to them. He did not himself suffer at the summit, which is 10,152 feet above the sea, and in an extremely rarefied air. At the edge of the sea his pulse beat from 62 to 65 times in the minute; at Nicolosi, situated at the height of 3200 feet, 72; in the Casa Gemellara, 9300 feet high, 80; and at the summit, 84. He concluded his narrative with expressing the wish that, in order to acquire more correct ideas regarding the height of mountains, these observa-

tions might be repeated by making water boil at different heights; and hoped that the improvements made in natural philosophy, might enable the Society of Catania to obtain a more accurate knowledge of the volcano.

5. *Meteor of a Green Colour.*—On the night of the 11th of February 1828, between eleven and twelve o'clock, as I was crossing the East River, between this city and Long Island, I observed a beautiful meteor, which was visible for about the space of two seconds. Its course was from a point perhaps 5° below the zenith, toward the horizon in a N.E. direction. It described an arc of perhaps 20°, when it apparently exploded, without any report that I could hear. Its colour was a singularly pure *grass green*, of a light shade; the tail which it left was of the same colour, and so were the scintillations which accompanied its apparent explosion. The latter were distinct, like those accompanying the bursting of a rocket, but by no means so numerous. Two gentlemen who were in the boat with me at the time also saw it.—*Silliman's Journal*, vol. xiv. No. I. *April*, 1828.

6. *On Thermo-Barometrical Observations.*—M. Horner presented last year, to the Helvetic Society of Natural Science, the results of observations made in January 1827, by M. Eschmann of Zurich, during an abode of fourteen days on the summit of Rigi, 5520 feet above the level of the sea, for the improvement of thermo-barometrical observations. There results, from a hundred and twenty observations made every hour, from seven in the morning to nine in the evening, and compared with simultaneous observations made at Zurich, that the height of Rigi above Zurich (which is 702 toises), is without any doubt ten toises greater by the observations made at noon, than by those made in the morning or evening. This results still more evidently from a series of a hundred and eighty-six observations made in June of the same year, only the latter give two toises more for the height. It appears that this augmentation of height, from one hour to another, is connected with the increase of temperature. The evening heights, however, diminish even when the heat still increases. The maximum of height coincides pretty well with noon. The summer observations give a height about seven toises greater than those made in winter. It

appears from this that a different height may be obtained for each season and each hour of the day. The author does not venture to offer an opinion respecting the causes of this anomaly, but he thinks that there is wanting a series of such observations, sufficient to enable us to discover the causes of these differences, as well as that of the co-efficients of the heights in our barometrical formulæ, and of the corrections rendered necessary by the changes of temperature. The correction necessary for the heat in a vertical direction, is exactly 97 toises for 1 degree of Reaumur, by the summer observations. The winter observations are of no use in this respect, on account of the southerly winds which prevail at these heights at that season. The daily oscillations of the barometer which, according to fourteen observations made daily at Zurich, appear very regular, cease entirely to exist at the summit of Rigi.—*Biblioth. Univers. Dec.* 1827.

HYDROGRAPHY.

7. *Blowing a River out.*—The southern mail failed at Washington on Tuesday last, in consequence of the gale, which was so long and so violent, as to blow the waters out of the Potomac to such a degree as to render it unnavigable.—*New York Paper.*

8. *Chemical Researches respecting the Mineral Waters of Geilnau, Fachingen, and Selters.* By G. Bischof. 8vo. Bonn, 1826.—Professor Bischof's interesting work on springs, entitled "Chemische Untersuchungen," &c. contains much curious and valuable information. The first chapter contains the analysis of three springs, and the second their geognostical relations. They issue from clayslate, and are in the vicinity of dolomites and igneous rocks. In the third chapter, the author treats of the relation of the composition and temperature of the springs to the surrounding rocks. The springs that are strongly impregnated with carbonic acid, and contain soda, are connected with the volcanic lines. They are scattered in seven volcanic groups, from the Eiffel to the Riesengebirge. He enumerates these groups, and connects with them the Pyrenees, Auvergne, and the Vivarais. In Switzerland, on account of the absence of basalt, there are none of these springs. The soda is furnished by the volcanic rocks. As all the springs contain more or less car-

bonic acid, the author supposes that this gas is generally produced in the interior of the earth, but this chemical process is only more active in volcanic or volcanised places. Muriatic acid and sulphuric acid exist only in springs that are in the vicinity of volcanoes in a state of activity. All the saliferous deposits are of volcanic origin. The air, acting upon the beds of sulphur, produces sulphurous acid and sulphuretted hydrogen. Sulphuric acid may be formed of sulphurous acid or pyrites. Muriatic acid is formed by the action of sulphuric acid upon salt. The carbonic acid circulating in all the volcanic rocks decomposes the alkalies and salts, and impregnates the springs with them. The two other volcanic acids also act; and thus is explained the formation of mineral springs. In the fourth chapter, the author considers the composition of mineral waters, the merit of their analysis, and of their artificial recomposition, their imponderable parts, the existence of mutually decomposing salts, &c. The following are the results of the analyses of these springs.

In 1000 parts there were found :

	GEILNAU. Temp. 8°5 R.	FACHINGEN. Temp. 8° R.	SELTERS. Temp. 12°5 R.
Carbonate of Soda -	7.9406	21.4036	7.6244
Sulphate of Soda, - -	0.1173	0.2198	0.3239
Muriate of Soda, -	0.3875	5.6145	21.2051
Phosphate of Soda, -	0.3660	0.0092	0.3579
Carbonate of Lime, -	0.5872	3.2506	2.4313
Carbonate of Magnesia, -	2.9073	2.2543	2.0772
Carbonate of Iron, -	0.2094	0.1161	0.2008
Silica, - -	0.1434	0.1137	0.3765
Free, or half combined, Carbonic Acid, - -	30.9588	25.6347	20.2752

9. *Petrifying quality of the Irawaddy.*—I formerly noticed the petrifying qualities of the water of the river Irawaddy: I now saw a strong proof of the rapidity with which it converts foreign bodies into stone. The pioneers were ordered to remove a house, which would have interfered with the defence of the stockade, if the enemy had assailed it. Upon endeavouring to cut down the massive teak-pillars on which it was raised, they found that the edges of their hatchets were all turned. On examining into the cause of this, they found that the pillars were petrified throughout, though the house had only been built ten years, and the

pillars were under water three months in the year during the monsoon.—*Alexander's Travels in Persia, &c.* p. 34.

10. *Phosphorescence of the Sea.*—Bory St Vincent maintains that luminous sea-water contains no infusory animals, and that the phosphoric light which it frequently exhibits is not a product of vitality.

MINERALOGY.

11. *Influence of Organic on Inorganic Bodies.*—Mr Hessle, in a memoir entitled " Influence of Organic on Inorganic Bodies," (*Einfluens des Organischen Korpers auf den Inorganischen.* Marburg, 1826), proves, in the introduction or preface, by examples, that organic remains have exercised an influence upon their mode of petrifying, and that the axes of the organized bodies have determined the axis of crystalline petrifying substances. The petrifactions of the radiaria present crystallizations of the rhombohedron, the regular six-sided prism, and the straight cylinder. The author enumerates their various positions in petrifactions. He gives an idea of the nature and form of the encrinites. The first chapter of this article contains the mechanical division of the stems of encrini, and the demonstration that the axis of the rhombohedron of the calcareous spar corresponds with that of the stem, and the rhombohedron is placed in it in four different ways, &c. The second chapter is devoted to considerations respecting the positions of the rhombohedrons in the aggregations of several pieces of encrinites. The author enumerates all the possible combinations at the meeting of two pieces, and presents a table of them. He considers the double pyramid with three faces and turned, which results from it, and describes the manner of observing these cases of meeting. In the third chapter he describes all the specimens which he has collected, and which appear so numerous that they present a large proportion of the possible combinations enumerated. Lastly, in the fourth chapter, he begins with observing, that, in each member of a branch of encrinus, the calcareous matter is placed in different geometrical relations; he enumerates encrini partially converted into pyrites and fluor; he asks of M., who mentions the latter, to determine the position of the octahedron of the fluor, &c.

12. *On Anthracite, or Glance-Coal. By* A. Breithaupt.—It has been long known that anthracite, or glance-coal, occurs chiefly in the intermediary formations; but opinions vary as to its mode of existence in these formations. In all the localities in which M. Breithaupt had an opportunity of observing it, such as Wezzelstein and Saalfeld, Lischuriz near Gerz, &c., it presented itself in veins, never in beds. In the autumn of 1826, M. de Warnsdorf discovered in the slate quarries of Wurzbach, near Lobenstein, in Voigtland, several quartzose veins, one of which contained a very interesting variety of anthracite. It occurs in isolated rods, which, like all the crystalline forms of this species, go from one of the sides to the other in a nearly perpendicular direction. These flakes are surrounded by quartzy fibres, perpendicular to their lateral surfaces, and consequently parallel to the plane of the vein, which seems to prove that their formation is posterior to that of the anthracite. M. Breithaupt enumerates all the reasons which induce him to consider these flakes as being really crystallized, and to refer the anthracite crystals to the system of crystallization of the prism, or rhomboidal octahedron.

13. *On the probable Occurrence of the Diamond in Siberia.*—It is expected that diamonds will be found in Siberia. A letter written by a travelling naturalist to the rector of the University of Dorpat, contains the following details:—The platiniferous sand of Nischni Toura bears a striking resemblance to that of Brazil, in which diamonds are commonly met with. According to the description given of it by M. Eschwege, this sand is principally composed of rolled fragments of hydrate of iron and jasper, and contains more platina than gold. The Nischni Toura sand is visibly formed of the same component parts; and the presence of hydrate of iron in it is so much the more remarkable, that it is in a conglomerate of the same kind that the Brazilian diamonds occur, that these two minerals are not associated merely by accident, but are the debris of one and the same formation. The author of this letter explains the reason why he could not engage in the search for diamonds, in a place where he is convinced they will be found. He communicated his observations to the director of Nischni Toura, who appeared disposed to commence operations.—*Zeitschrift fur Mineralogie, February,* 1827.

GEOLOGY.

14. *Fossil Bones in the Cave of Miremont.*—M. Brongniart, in July 1828, at a meeting of the French Academy of Sciences, gave an account of a letter which he had received from M. Jules Delanoue, dated Souffignac, near Miremont, 15th July 1828. The author of the letter had discovered in the Cave of Miremont, in the Department of the Dordogne, fossil bones in general resembling those which have been found in the caves of Germany and England, and latterly in several of those of France. In the description of this cave, inserted in the Annales des Mines (t. vii. p. 597, 1822), it was remarked that no fossil bone had been discovered in it; but at that period Mr Buckland had not published his inquiries respecting the position which these organic remains commonly have in all the caves in which they have been successively discovered. M. Delanoue gives the following statements with respect to this new example of the surprising constancy of this geological phenomenon:—The cave, which is very large, is formed in a deposit which appears to belong to the chalk, or to the formations intermediate between the chalk and the jura limestone. It is of much greater dimensions than the plan inserted in the Annales des Mines indicates. The galleries are so much the narrower the more they are branched, and are prolonged without any very remarkable contraction or dilatation, for 2000 yards or more. All the galleries end in a multitude of narrow and low ramifications, which may be compared to the springs and brooks that feed a river. It was in these parts that M. Delanoue found most of the bones. The floor is of red tenacious clay, containing fragments of flint and shells. Bones are not found either in the white mud, or in the earth, resulting from the crumbling of the walls, but in the red clay alone. The bones occur at all depths, as well as at the surface. In the latter case they are friable and broken. They are chiefly teeth and bones, which M. Delanoue supposes to belong to the Ursus bombifrons, whose fossil remains are found at Iserlohn, and in other caves in Germany. M. Delanoue observes that the Miremont cave presents no stalactites. This circumstance, which had been already pointed out, is rather rare in

caves, and especially in those containing bones, where these incrustations often cover the organic remains. By digging at the distances of 200 and 400 yards from the entrance, there have been discovered, beneath several layers of marl, which appear to be of a much more recent formation than that of the red clay, the *remains of pottery*, which, in its colour and nature, presents the greatest resemblance to the potteries which are found, though rarely, in some ruins, and in some deposits of modern alluvia, and which, from the nature of their paste, their colour, form, and other circumstances, are referred to the times preceding the introduction of Roman arts among the Gauls.

14. *On Coral Islands.*—According to Linnæus and Ellis, the calcareous zoophytes, such as the tubipores, millepores, and madrepores, are inhabited by animalcules, which have some affinity to the nereids, medusæ, and hydræ; but more recent investigations have shewn, that all the corals which form rocks, or *Saxigenous lithophytes* of the French zoologists, and even the *Pavonia Caryophyllea* and the *Nullipora* of Lamarck, serve as a habitation to gelatinous mollusca of a particular kind, or are surrounded by them. Since Cook's voyage, Forster's observations have given occasion to geologists to think that many islands and entire countries have owed their origin to the coral produced by these animalcules. I have seen some of these coral islands covered with a pitiful vegetation, and I have no doubt that many of those of the Pacific Ocean have been formed in this manner. It appears to me, however, that too much importance has been attributed to this theory, on which M. Adelbert de Chamisso, an excellent observer, has thrown much light. In the West Indies, for example, limestone rocks of tertiary formation, which contain petrified madrepores and tubipores, have been taken for recent works of coral animals, merely because they occur in places where similar animals are still observed. But when we penetrate into the interior of the large Antilles, there occur mountains of primitive formation, which to a great height are surrounded by the same madrepore rocks. These rocks have, consequently, emerged from the chaos of an ancient world. Between the tropics, on the shores of the Gulf of Mexico, the traveller runs the risk of confounding with

old coral beds, strata of tertiary limestone, which are placed above chalk, and filled with coral petrifactions.—*Humboldt, Tableaux de la Nature*, t. i. p. 90.

15. *On Brown Coal, or Lignite, and Oolite, superimposed on Chalk; discovered in Bessarabia by M. Eichfield.*—In a geological point of view, this brown coal or lignite is chiefly worthy of attention from the circumstance of its facilitating the study of the tertiary rocks, which have hitherto been so little examined. According to the commonly received geological opinions, founded on the examination of mountains in Germany, France, England, Switzerland, Italy and part of Scandinavia, and confirmed by Humboldt's observations in the mountains of America, lignites ought to occur with the plastic clay, above a formation of chalk. In Bessarabia, the chalk formation appears at the surface, in the neighbourhood of Mohilef, on the Dniester, and extends into Moldavia, in the north-east direction. The formations situated between this chain of chalk mountains and the sea present no analogy to the tertiary formation of France. Here, above the chalk, there occur, 1*st*, To a fathom and a half, a coarse sand; 2*d*, An argillaceous rock, containing some lime, and of which the lower part is somewhat silicious, eight inches; 3*d*, A cretaceous limestone, five feet thick, ending in oolite in its upper parts; 4*th*, Then a thin bed of sand and compact limestone; 5*th*, Lastly, the whole plain to the sea and the Danube is solely composed of horizontal limestone, filled with shells. In the cavities of this principal formation, and generally between the territory of Brender and the sea, in the direction of north-west, there occurs silicious limestone, with remains of shells, among which pinnites are also seen. At a great distance from the sea, on the banks of the Bouik, the Reoute, the Koula, and other rivers, this limestone is covered with soft marls containing crystals of selenite. From the line of Brender to Boudjak, immediately over the sand, lies a transported limestone *(Calcaire meuble)*, composed almost entirely of shells, and more or less mixed with iron ochre. *Large beds of oolitic limestone form the distinctive character of this formation which lies above the chalk, and to which geologists give the name of tertiary, although frequently the oolite limestone presents itself under that of Jura limestone, as one of the principal*

elements of the secondary formations.—*Bulletin. Univers.*, *April* 1828.

BOTANY.

16. *Inquiries respecting the Pollen of Vegetables.*—On the 21st July 1828, there was read, to the Academie des Sciences, a letter from M. Raspail, respecting the spermatic animalcules which M. Adolphe Brongniart thought he had discovered in the pollen of vegetables, and whose existence M. Raspail persists in denying. The author, whose object was particularly to reply to M. Brongniart's last memoir, mentioned, that this young observer having presented the pollen of the *Malvaceæ*, as that in which he had met with the largest animalcules; it was toward this same pollen that his own inquiries were naturally directed. The result of these inquiries was the conviction, that the alleged animalcules were nothing but minute drops of substances soluble in alcohol. M. Adolphe Brongniart admits, in his new work, that resinous drops are emitted, in great numbers, during the explosion of the pollen, a circumstance of which he took no notice in his first memoir. Faithful to his first opinion, he however asserts, that these drops have nothing to do with his animalcules; "but, in order to prove it to us," says M. Raspail, "in place of making the experiment upon the pollen of the malvaceæ, he has recourse, all of a sudden, to the pollen of other families, and finds, that, in these, the animalcules do not dissolve in alcohol, but only lose their motion in it." As resin, wax, and essential oil, do not, by any means, exist in the same proportions in the pollen of different plants, as M. Raspail has proved in a former memoir, it is not surprising that M. Brongniart should not find, in the pollen of the gramineæ, so great an abundance of resinous drops as in the pollen of the malvaceæ; or that he should see round bodies in it, which did not dissolve in alcohol. But it is obviously on the malvaceæ that the experiments in question ought to have been repeated. M. Brongniart's mode of operating, also, is so inaccurate, that M. Raspail is compelled to doubt whether he employed his process in the manner which he points out. He says he poured alcohol on the animalcules in motion; in other words, and by consequence, into the drop of water in which they were moving, and yet did

not see them dissolve. "Now, alcohol poured upon water cannot dissolve, at least instantaneously, drops of resin, as every one knows who has been accustomed to make experiments of this kind. Moreover, it then produces so violent a microscopic tempest, that it becomes impossible for the observer to distinguish any thing. In another experiment, the author covered, with a plate of mica, the drop of water in which he had broken a grain of pollen; but, the plate of mica, at the moment when he placed it upon the drop of water, must have removed from his view the bodies which it fixed; and, besides, the edges of a plate of mica, which are always ill applied against the object-bearer, cannot, by any means, prevent the evaporation of the fluid, which becomes a powerful cause of automatic motion. We advise the author, when he proceeds anew with such experiments, to place a sufficient quantity of water and grains of pollen in the cavity of a plate of glass, and cover it with another, making the latter slide over the former, without allowing the air to insinuate itself into the cavity. The pollen will burst. The explosion will indeed put the whole in motion, but, in a few moments after, our little automatons will resume the immobility of all inert globules. I have repeated these experiments a hundred times. Many others have repeated them since; and M. Brongniart is hitherto the only person who persists in holding so ill-founded an opinion." The vague and indeterminate motion, which appears to M. Brongniart so peremptory a proof of the spontaneousness of the corpuscules in question, seems, to M. Raspail, a proof of the contrary opinion; for any globules of albumen, gluten, starch, and still more of essential oil, suspended in water, will present traces of a vague and indeterminate motion. "I therefore," says M. Raspail in conclusion, "persist in asserting, that Gleichen's pretended animalcules are nothing, in the malvaceæ especially, but resinous drops; and, in other pollens, but inert globules of tissues mixed with these drops." M. Raspail concludes his letter with observations respecting the comparative value of different microscopes. In his opinion, *Amici's Microscope* (which M. Brongniart employs, and for this reason considers his experiments as peculiarly valuable), *is*, other things equal, *inferior* to every other microscope. Any one having the least knowledge of optics, might convince himself of this *a priori;* and what theory points out in this matter, experience confirms. The most expert observers of Paris have long remarked, that objects which are distinctly seen with the vertical achromatic microscope, are not perceptible with Amici's microscope, and more than one observer has already repented of having sacrificed the former, for the expensive agate of the latter.—*Le Globe.*

18. *On the Organization of the genus Chara.*—There was read to the Academie des Sciences of Paris, on the 21st July 1828, a letter from M. Raspail, respecting the organization of the genus *Chara.* Botanists and Natural Philosophers have hitherto been much puzzled by the existence of two opposite currents of green matter, in the interior of the tubes of this genus, which never intermingle, although there is no partition between them. M. Raspail gives a very simple explanation of this singular phenomenon. "Having brought near the flame of a lamp," says he, "a tube closed at one end, and filled with alcohol, holding a multitude of globules of fat in suspension, I soon observed a current of globules proceeding upwards on one side, and again descending on the other, to continue the same motion without intermission. So long as I kept the tube at the same temperature, the two currents never mingled; and, during the whole continuance of the experiment, there existed a visible line of demarcation between them. In a word, my glass-tube was an exact representation of the tube of a chara, which is, in fact, nothing but a transparent tube closed at both ends, lined with a layer of green matter, and in which there are distinguished an ascending and descending current." M. Raspail produced a glass-tube containing sawings of wood, of which it was sufficient to heat the base with the hand, to produce the phenomenon. The two currents were quickly established after a few oscillations. Then followed, in the letter, the physical explanation of the phenomenon. In reality, in the chara, it is not the heat that determines the twofold motion, but the aspiration and expiration of water operated by the tube, as M. Raspail has already demonstrated. The phenomenon in question has also been produced by him in glass-tubes, by means of an artificial aspiration and expiration.—*Le Globe,* 26. *Juillet* 1828.

19. *Account of a new Species of Pinus, a native of Califor-*

nia, discovered by Mr David Douglas.—In Vol. xv. of the Transactions of the Linnean Society, there is an account of a new and interesting species of pine, from California, by Mr Douglas, who proposes to name it *Pinus Lambertina*, and gives the following as its specific character. P. foliis quinis rigidis scabrusculis, vaginis brevissimis, strabilis crassis longissimis cylindricis; squamis laxis rotundatis. It covers large districts in Northern California, about a hundred miles from the ocean, in Lat. 43° north, extending as far to the south as 4°. It grows sparingly upon low hills, and the undulating country east of a range of mountains, running in a south-western direction from the Rocky Mountains towards the sea, where the soil consists entirely of pure sand. The trees do not form dense forests, like most of the other pines which cover the face of North-West America, but, like those of *Pinus resinosa*, are scattered singly over the plains. The trunk attains a height of from 150 to 200 feet, varying from 20 to near 60 feet in circumference. The trunk is unusually straight, and destitute of branches about two-thirds of the height. The bark is uncommonly smooth for such large timber, of a light brown colour on the south, and bleached on the north side. The branches are rather pendulous, and form an open pyramidal head, with that appearance which is peculiar to the Abies tribe. The leaves are rigid, from 4 to 5 inches long, of a bright green colour, and grow in fives. The cones are pendulous from the extremities of the branches, and, when ripe, are about 11 inches in circumference at the thickest part, and from 12 to 16 inches in length. The scales are lax, rounder, and destitute of spines. The seeds are large, eight lines long, and four broad, and of an oval form. Their kernel is sweet and pleasant to the taste. The embryo has twelve or thirteen cotyledons. The timber is white, soft, and light. It abounds in turpentine reservoirs, and its specific gravity is 0.463. The whole tree produces an abundance of amber coloured resin. That which exudes from the trees, when they are partly burned, loses its usual flavour, and acquires a sweet taste, in which state it is used by the natives as sugar, being mixed with their food. The seeds are eaten roasted, or are pounded into coarse cakes for their winter store. The vernacular name, in the language of the Umpique Indians, is Natcleh.

20. *Nutritious Substance transported by the Wind.*—M. Thenard presented to the French Academy of Sciences, in August 1828, a substance, which was communicated to him by the Minister for Foreign Affairs. This substance was sent to the Minister, as having fallen from the sky, in Persia, at the commencement of the present year. It occurred in such abundance that the ground was of a sudden entirely covered by it over a great extent. In some spots it was five or six inches deep. It was eaten by cattle, and particularly sheep; and bread was made of it, which afforded nourishment to man. Such were the accounts furnished to the French Consul in Persia, by a Russian general, who was an eye-witness. M. Thenard had first presented the specimens to M. Desfontaines, who recognized in them a species of lichen described by botanists. These lichens, which, it would appear, occur in very great abundance, had been transported by the wind to the places where their sudden appearance was observed. A similar phenomenon occurred in the same parts of Persia in 1824[*].

21. *On the Fecundation of Flowers.*—Formerly the fecundation of flowers, in which the sexes are separated, was almost wholly attributed to the wind. Kohlreuter and Sprengel have proved, with an astonishing sagacity, that bees, wasps, and a great number of small winged insects, perform the principal part in this operation. I say the principal part; for to assert that the fecundation of the germen absolutely cannot take place without the intervention of these little animals, does not seem to me in conformity with the genius of nature, as Wildenow has demonstrated at length[†]. But, on the other hand, it must be observed, that dichogamy, the coloured spots of the petals, which indicate the vessels in which the honey is contained, and fecundation by the contact of insects, are three circumstances almost inseparable.—*Humboldt, Tabl. de la Nat.* t. i. p. 78.

22. *Erica ciliaris*, L.—This beautiful species of heath was added to the British Flora a short time ago, by the Rev. Mr

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[*] Specimens of this substance were sent to us, from Persia, by Mrs Macneill, lady of the physician to the embassy in Persia.—Edit.

[†] Elements of Botany (in German), p. 405.

Tozer, who observed it in several bogs in the neighbourhood of Truro, Cornwall. The corolla is ovate, resembling that of *E. cinerea* in colour, but is much larger, and the anthers are neither horned nor crested.

ZOOLOGY.

23. *New method of quickly destroying the life of Insects.* By M. A. Ricord, traveller to the Royal Museum of Natural History at Paris, &c.—The insect is fastened to a bit of cork, and placed under a bell with a little sulphuric ether, which is either poured into a vessel, or upon the floor of the bell. The latter must be perfectly fitted to the plane on which it rests, to prevent the escape of the ether when it evaporates. The insect immersed in this atmosphere dies instantly, before it has had time to struggle, and thus retains all the freshness of its colouring.—*Bulletin Universel.*

24. *On the Tyrian Purple.* By M. Lesson.—Pliny has described two kinds of shells, in the 4th Book of his Natural History, as furnishing the celebrated purple with which the robes of the Roman nobles was dyed. He names the one *Buccinum*, the other *Murex.* There has been much disagreement respecting the buccinum. On comparing Pliny's description, however, with the species of mollusca which inhabit the Mediterranean, there can remain no doubt that it is the *Janthina fragilis* of modern naturalists. This shell is pelagic, and floats on the sea in prodigious quantities. It is supported at the surface by air vesicles, which Pliny calls a glutinous wax; and the moment it retires under the water allows to escape a very pure and bright reddish-purple colour. Each animal contains a considerable quantity of it in a dorsal vessel. With alkalies, this colour readily assumes a green tint, and confirms what Pliny says on this subject. What is taken for a long tongue is the head of the animal, which is in fact rounded, and of firm consistence. The Janthina is extremely common in the Mediterranean and in the Atlantic, for the shores of St Helena and the Island of Ascension are, at certain seasons, entirely covered with them. The second species of purple appears to be really the Murex of the ancients, or the shell named Chicorée, and not that called Purpura. Some imperfect trials that we have made with the colour of the Janthina

have satisfied us that it would form a very valuable reagent; for it passes very readily to red under the action of acids, and returns to blue under that of alkalies. With the oxalate of ammonia, it gives a precipitate of a deep blue colour, and with nitrate of silver a very pleasant greyish-blue colour, which furnishes a very good colour for drawing.

25. *Microscopical Observations on Fresh-Water Mussels.*—M. Raspail read to the Academie des Sciences, on the 14th July 1828, a letter, in which he detailed the results obtained by him from new microscopical observations made on fresh-water mussels. "Having placed," says the author, "on the 1st July, two fresh-water mussels in a glass jar, I observed that the excrementitial extremity expelled at certain intervals a small parcel of a yellowish-white colour, and about half a centimetre long. This granular parcel, when torn asunder on the object-bearer, gave out a number of small bivalves, which opened and shut their shells in a lively manner. Each of the valves was of a triangular form, the hinge forming the hypothenuse. When open, they were one-third of a millimetre in length, and one-sixth when closed. This triangular form disappeared when the two valves ceased to be parallel to the object-bearer; the animal was scarcely distinguishable from the granulations of the shell. In another parcel, I found bivalves furnished with an umbilical cord, the commencement of which proceeded from one of the notches formed by the commissure of the two valves." Lastly, when these bivalves were placed on the edges of their shell, it was easy to distinguish, on the umbo of each valve, an apex, turned inwards, nearly at a right angle, formed by a rib, similar to that which in this position surrounds each valve like a rim. But this apex was accompanied on each side by a membranous prolongation, which was attached to the edges of the valves. M. Raspail mentioned the experiments which led him to conclude that the apex of the young shells observed by him is at that period formed solely of phosphate of lime, and that there is scarcely any carbonate in it. His new observations confirm, 1*st*, What M. Jacobson has said respecting the two umbones, which that author, however, has not, in his opinion, described with accuracy; and, 2*d*, The existence of the umbilical cord described by Kœlreuter. But these observations invalidate

M. Jacobson's opinion respecting the parasitic nature of the young shells, for how can it be conceived that parasites should be contained in a parcel, like the eggs of the mollusca, and ejected by the animal itself? They also invalidate what M. de Blainville has mentioned respecting a parcel of eggs expelled by the animal. As to M. Jacobson's argument, derived from the presence of umbones in these young bivalves, in favour of the opinion which considers them as parasites, it does not appear to me capable of being adopted; for, might it not be the case, that these small umbones were already the rudiments of all those protuberances which form on each edge of the valves on the two sides of the hinge, and which are destined to give so great a solidity to the two valves when they are applied to each other? These umbones are rather appendages inserted upon the rim of the valves than a portion of the valves themselves."

ANTHROPOLOGY.

26. *Diversity of taste respecting Food.*—We have many examples of the partiality of comparatively civilized races of men to a diet, which to us appears loathsome and offensive, and which these nations, from habit, or naturally depraved taste, would prefer to the choicest dishes at an alderman's dinner in Guildhall. The Pariahs of Hindostan (it is observed in a recent work), attracted by the stench of rotten carcases, fly in crowds to dispute the infectious carrion with the dogs, and other birds of prey. They share the mass of corruption, and return to their dens to devour it without rice, seasoning, or any other accompaniment. Little do they care of what disease the animal may have died, for they make no scruple to poison secretly their neighbours' oxen and cows to provide a savage repast for their ravenous appetites. The bushmen of southern Africa generally eat the flesh raw; and when they cook it, they only warm it, and apply their teeth to it the moment it is taken from the ashes. The inhabitants of the Kurulean Isles are very partial to bear's liver. Chinese are not particular in their choice of animal food; cats, dogs, rats, and almost every species of animals, serpents, &c.; and which have either been killed or died a natural death. It was a practice in China, at one time, for tavern keepers to put to death a fat guest, when opportunity served, and to make

pies, &c. of the flesh, for the entertainment of their other guests, who were not so fortunate as to be so well fed. Bears' paws, birds' nests, and sea-slug, are considered great delicacies. The Thibetians prefer raw to roasted mutton. The Cochin Chinese prefer rotten eggs to fresh; putrid eggs cost more than the latter by 30 per cent.—*Chinese Chronicle of Malacca.*

27. *A Woman delivered of Five Children.*—A female peasant of the village of Loukin, district of Balakhnin, in the government of Nijegorad, aged twenty-five years, of small stature, but robust constitution, was married at seventeen. The second year of her marriage she was brought-to-bed of a girl, which died at the end of fifteen days. The fourth year she was delivered, after a gestation of eight months, of twins. The first, which was a boy, lived only five days; the other, a girl, died after six days of the most cruel sufferings. In the month of November 1824, the same woman was delivered of five children, bringing successively into the world a girl on the 9th, 10th, 12th, and 13th, and a dead boy on the 16th. Each of these infants was only about eight inches long. The four girls died on the sixth day after birth. The mother was restored to perfect health in a month after parturition. Nothing particular had been remarked either by herself or by the midwife, with the exception of an extraordinary tumefaction of the abdomen, together with swelling of the feet, violent headaches, deafness, and frequent hemorrhages by the mouth and nose, during the second month of gestation. Neither her own nor her husband's family had ever presented a similar example.

28. *Population of England.*—The United Kingdom of Britain and Ireland contains 74 millions of acres, of which, at least, 64 millions of acres may be considered capable of cultivation. Half an acre, with ordinary cultivation, is sufficient to supply an individual with corn, and one acre is sufficient to maintain a horse; consequently, the United Kingdom contains land enough for the sustenance of 120 millions of people, and 4 millions of horses.—*Edmunds on Political Economy.*

29. *Method of Tattooing.*—The men are tattooed very closely from the waist to below the knee, with different figures of animals, charms, &c. I saw a woman with *the white of one of her eyes tattooed.* The process is performed with a long steel

needle, loaded at one end, and divided at the other to contain the liquor, which is either red or blue: it draws blood at every stroke.—*Alexander's Travels.*

30. *On the predominance of the Right Arm over the Left.*—M le Comte, in a memoir relative to the predominance of the right arm over the left, in the Journal de Physiologie Experimentale for January 1828, commences with refuting the opinion of those who have attributed this predominance to habit. He then passes under review the different hypotheses of physiologists, who have hitherto looked for the cause of this phenomenon in the normal organization of man, and finds all that has been proposed inadequate. He at length comes to his own hypothesis. In his opinion, the difference between the right and the left system has its source in the position which the human fetus affects in the uterus during the last months of gestation. In by far the greater number of cases, the position is such that its left arm and shoulder, as well as the left side in general, are pressed against the bone of the pelvis. From this pressure there results a contraction of the bloodvessels, a sort of atrophy commencing in the whole left system. The weakness of that side, therefore, results from this congenital disposition. M. Comte, with the view of obtaining a verification of his theory, compared the cases in which the fetus occurs in the position which he considers as calculated to determine the weakening of the left system, with those in which it assumes a contrary position; and he has found a number which expresses the proportion of right-handed and left-handed persons. Having been for several years a resident pupil in the Maison Royale d'Accouchemens, M. Comte occupied himself in observing the habits of the children which, at the moment of their birth, he had supposed would be left-handed, and he found his prognostications verified. He proposes to make a further trial on the children placed in the Hospice de Orphelins, with respect to whom it would be possible to ascertain the peculiar circumstances that attended their birth. He concludes with considerations respecting the means of enabling children to use both sides freely. To ensure this happy result, it is not enough to make children use both hands alike after they are two or three years old. To compensate the defective condition of the left system at the moment of birth,

they must be forced to use it solely, leaving the right system in a state of inactivity. The reverse of this is generally what takes place. Nurses, in fact, usually carry children on the right arm. In this position the child has the whole left side pressed against the breast of the nurse, which cannot but increase the disposition acquired at birth.—*Bulletin Universel, April* 1828.

ARTS.

31. *Artificial Ultramarine.*—M. Gay Lussac presented, at a late meeting of the French Academy of Sciences, a specimen of artificial ultramarine, manufactured by M. Guimet. He observed, that this ultramarine, which is of a quality superior to that of the finest specimens hitherto sold, has been employed by several painters, who have expressed their satisfaction with its numerous excellent qualities. He mentioned also, that M. Guimet's ultramarine may be delivered to the consumers at the rate of 25 francs per ounce, or at two-thirds of the price of natural ultramarine of good quality. As soon as M. Guimet's discovery was announced by the public journals, a foreign chemist, M. Gmelin of Tubingen, gave out that he also possessed a process for the manufacture of artificial ultramarine. He even published his recipe. M. Guimet, who keeps his a secret, is doubtful whether ultramarine can be obtained by M. Gmelin's process at the price at which he himself delivers it to commerce.

STATISTICS.

32. *Culture of Turnips.*—Until the beginning of the eighteenth century, this valuable root was cultivated among us only in gardens or other small spots for culinary purposes; but Lord Townshend, attending King George the First in one of his excursions to Germany, in the quality of Secretary of State, observed the turnips cultivated in open and extensive fields, as fodder for cattle, and spreading fertility over lands naturally barren; and, on his return to England, he brought over with him some of the seed, and strongly recommended the practice which he had witnessed to the adoption of his own tenants, who occupied a soil similar to that of Hanover. The experiment succeeded; the cultivation of field turnips gradually spread over the whole county of Norfolk; and, in the course of time,

it has made its way into every other district of England. The reputation of the county as an agricultural district, dates from the vast improvements of heaths, wastes, sheep-walks and warrens, by enclosing and manuring—the fruit of the zealous exertions of Lord Townshend, and a few neighbouring land-owners—which were ere long happily imitated by others. Since these improvements were effected, rents have risen in that county from one or two shillings to fifteen or twenty shillings per acre; a country of sheep-walks and rabbit-warrens has been rendered highly productive; and, by dint of management, what was thus gained has been preserved and improved even to the present moment. Some of the finest corn crops in the world are now growing upon lands which, before the introduction of the turnip husbandry, produced a very scanty supply of grass for a few lean and half-starved rabbits. Mr Colquhoun, in his "Statistical Researches," estimated the value of the turnip crop annually growing in this country at fourteen millions; but, when we further recollect that it enables the agriculturist to reclaim and cultivate land which, without its aid, would remain in a hopeless state of natural barrenness; that it leaves the land so clean and in such fine condition, as almost to insure a good crop of barley and a kind plant of clover, and that this clover is found a most excellent preparative for wheat, it will appear that the subsequent advantages derived from a crop of turnips must infinitely exceed its estimated value as fodder for cattle. If we were, therefore, asked to point out the individual who, in modern times, has proved the greatest benefactor to the community, we should not hesitate to fix upon the ingenious nobleman, whom the wits and courtiers of his own day were pleased to laugh at as "Turnip Townshend." In something less than one hundred years, the agricultural practice which he introduced from Hanover has spread itself throughout this country, and now yields an annual return which probably exceeds the interest of our national debt.—*Sir Walter Scott, in the Quarterly Review.*

List of Patents granted in Scotland from April 26. to July 22. 1828.

1828,

Apr. 26. To William Marshall of Fountain Grove, parish of Huddersfield, county of York, shear-manufacturer, for "improvements in machinery for cutting or shearing, cropping, and finishing cloth, and other articles manufactured from wool, or other raw materials."

To Thomas Breidenbach of Birmingham, county of Warwick, merchant, for "a machine, or improved mode by use of machinery, for forging or manufacturing tubes or rodes, or for other purposes."

To James Griffin of Whitley Moor Works, near Dudley, Worcestershire, scythe-manufacturer, for "an improvement in the manufacturing of scythe-backs, chaff-knife backs, and hay-knife backs."

29. To John James Watt of Stacy Street, Stepney, Middlesex, surgeon, for "the application of a certain chemical agent, by which animal poison may be destroyed, and the disease consequent thereon be effectually prevented."

To Charles Carpenter Bompas of the Inner Temple, Esq. for "improvements in the propelling of locomotive carriages and machines, and boats, and other vessels."

May 1. To Thomas Hillman of Millwall, Poplar, Middlesex, mast-maker, for "certain improvements in the construction and fastening of made masts."

To Jonathan Brownill of Sheffield, Yorkshire, cutler, for "an improved method of transferring vessels from a higher to a lower level, or from a lower to a higher level, on canals; also for the more conveniently raising or lowering of weights, carriages, or goods on rail-roads, and for other purposes."

6. To James Palmer of Globe-road, Mile-end, Middlesex, paper-maker, for "improvements in the moulds, machinery, or apparatus for making paper."

To Thomas Adams of Oldbury, county of Salop, manufacturer, for "improvements on instruments, trusses, or apparatus for the relief or cure of hernia or rupture."

To Francis Westby of Leicester, cutler, for "certain improved apparatus to be used for the whetting or sharpening the edges of the blades of knives, or other cutting instruments."

To Samuel Brooking, Esq. of Plymouth, Devonshire, a rear-admiral in the royal navy, for "a certain turning or slipping fid, for securing and releasing the upper masts of ships and vessels."

To Matthew Fullwood jun. of Stratford, Essex, gentleman, for "a cement, mastic, or composition, which he intends to denominate German cement."

May 1. To **John Benjamin Macniel** of Folshill, Coventry, engineer, for "certain improvements in preparing and applying materials for the making, constructing, or rendering more durable, roads and other ways; which materials are applicable to other purposes."

13. To **Thomas Jackson** of Red Lion Street, Holborn, Middlesex, watch-maker, for "a new metal stud, to be applied to boots and shoes, and other like articles of manufacture."

To **John Ford** of Wandsworth Road, Vauxhall, Surrey, machine-maker, for "certain improvements in machinery for cleaning, opening, scribbling, carding, combing, slabbing, and spinning wool, and for carding and roving, or slivering and spinning, cotton, short-stapled flax, hemp, and silk, either separately or combined."

To **Thomas Bonsor Crompton** of Tamworth, Staffordshire, papermaker, and **Enoch Taylor** of Marsden, Yorkshire, millwright, for "improvements in that part of the process of paper-making which relates to the cutting."

17. To **Charles Chubb** of St Paul's Church-yard, London, patent-lock manufacturer, for "certain improvements in the construction of latches, which may be used for fastening doors or gates."

To **Thomas, William,** and **John Powell,** of the city of Bristol, glass-merchants and stoneware manufacturers, for "improvements in the process, machinery, or apparatus, for forming, making, or producing moulds or vessels for refining sugar; and in the application of materials hitherto unused in making the said moulds."

June 25. To **Samuel Pratt** of New Bond Street, Hanover Square, Middlesex, camp equipage-maker, for "improvements in elastic beds, cushions, seats, pads, and other articles of that kind."

July 3. To **John Baring** of Broad Street Buildings, in the city of London, merchant, for "an improved method of making or manufacturing machines for cutting hair from skin, for the use of hatters, to be called 'The Cant-twist Blades Fur Cutter;' communicated from abroad."

5. To **John Johnston Isaac** of Star Street, Edgware Road, county of Middlesex, engineer, for "improvements in propelling vessels, boats, and other floating bodies."

10. To **Thomas Revis** of Kensington Street, Walworth, county of Surrey, watchmaker, for "an improved method of lifting weights."

To **John Hawks** of Weymouth Street, Portland Place, county of Middlesex, iron-manufacturer, for "an improvement in the construction of ships' cable and hawser chains."

To **John Henry Anthony Gunther** of Camden Town, county of Middlesex, piano-forte manufacturer, for "improvements on piano-fortes."

To **William Muller** of Doughty Street, Bedford Row, county of Middlesex, captain in the German Legion, for "an apparatus for the purpose of teaching in the mathematics, geography, astronomy, and other sciences; and for resolving problems in navigation, spherics, and other sciences."

July 17. To Benjamin Rider of Bedcross Street, Southwark, county of Surrey, for "improvements in the manufacture of hats."

To Joseph Jones of Amluch, Anglesea, North Wales, gentleman, for an "improvement in the process of smelting, or obtaining metallic copper from copper-ore."

List of Patents granted in Scotland from June 20. to August 5. 1828.

1828,

June 20. To William Rodger of Norfolk Street, Strand, in the county of Middlesex, Lieutenant in the Royal Navy, for "certain improvements on anchors."

To John Davis of Leman Street, Goodman's Fields, in the county of Middlesex, sugar-refiner, for an invention communicated to him by a foreigner residing abroad, of "an improvement in boiling or evaporating solutions of sugar and other liquors."

July 11. To Thomas Stanope Hollond of the city of London, Esquire, for, "certain combinations of machinery for generating and communicating power and motion applicable to the propelling fixed machinery, as also floating bodies, carriages, and other locomotive machines and instruments."

16. To Henry Pinkus of Philadelphia, in the State of Pennsylvania, now residing in Regent Street, in the Parish of St James's, Westminster, gentleman, for "certain improvements in the method or apparatus for generating carburetted hydrogen gas, and in purifying the same."

Aug. 5. To Maurice de Jongh of Manchester, in the county of Lancaster, machinist, for "an improvement or improvements in machines adapted for spinning, doubling, twisting, roving, or preparing cotton, and other fibrous substances."

LIST OF PLATES.

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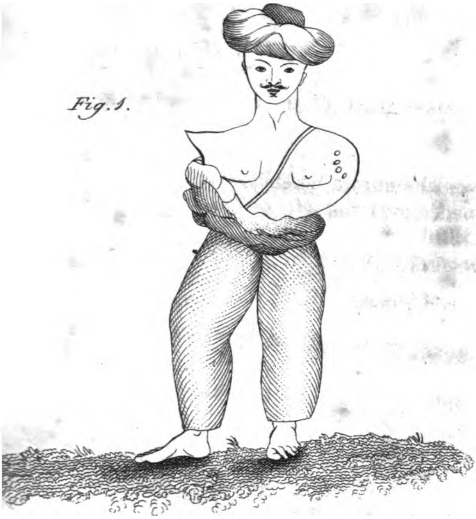

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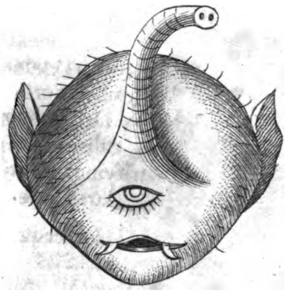

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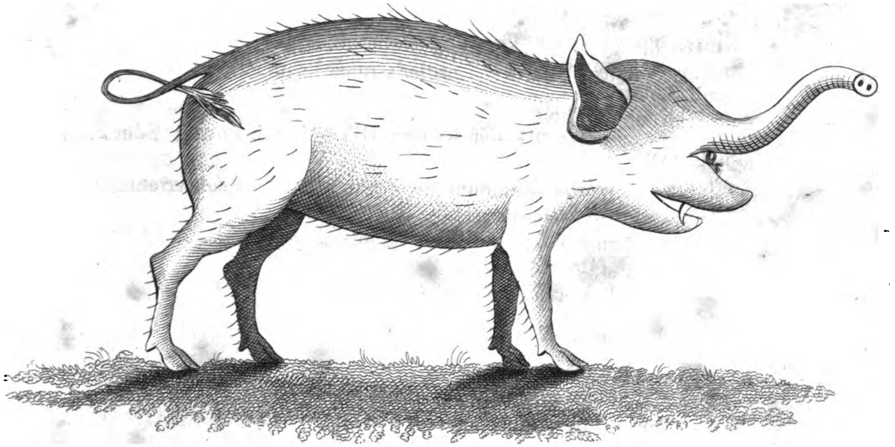

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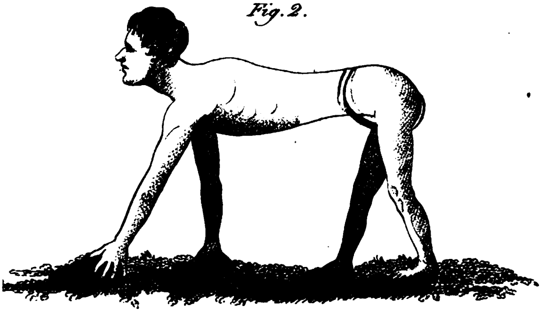

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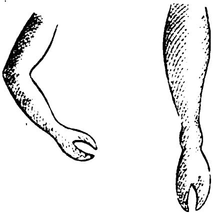

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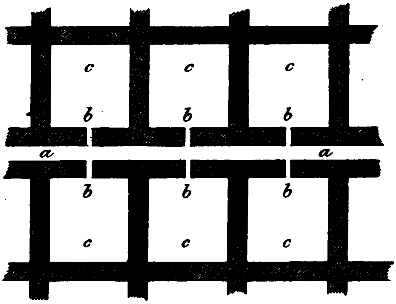

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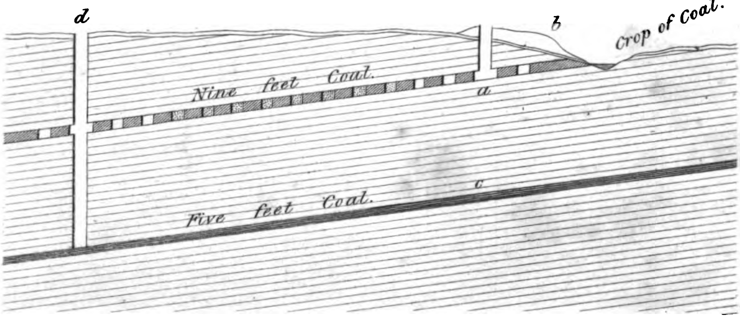

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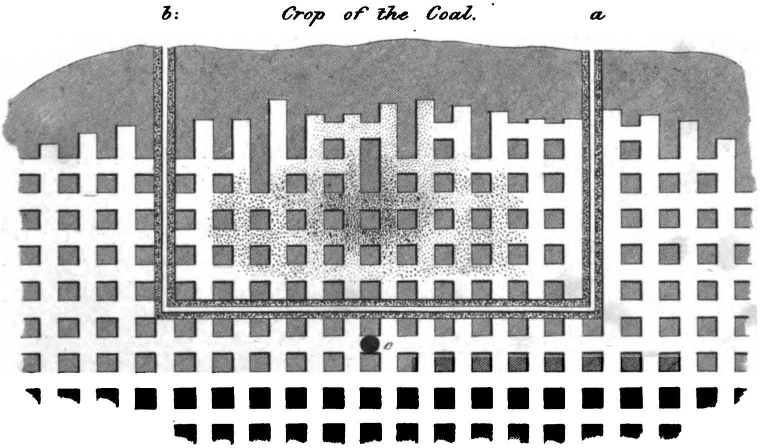

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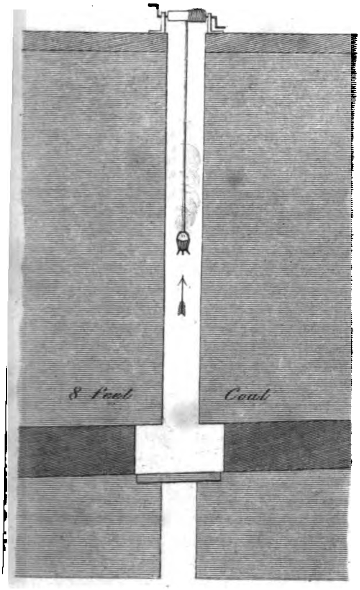

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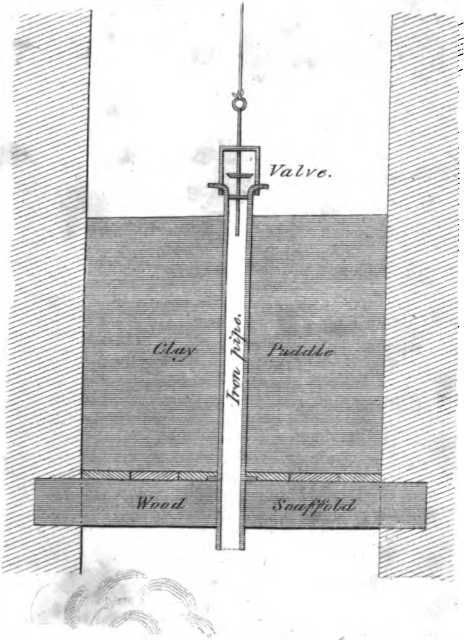

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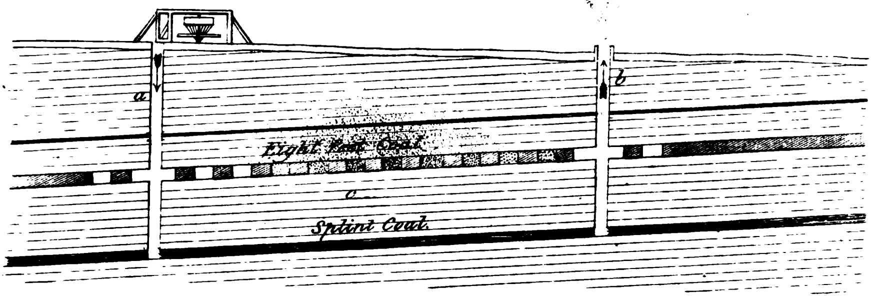

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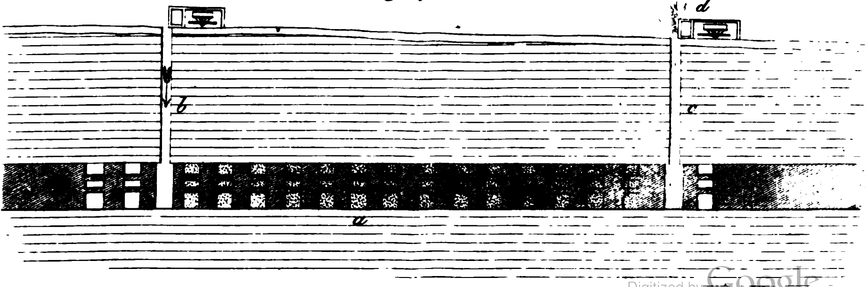

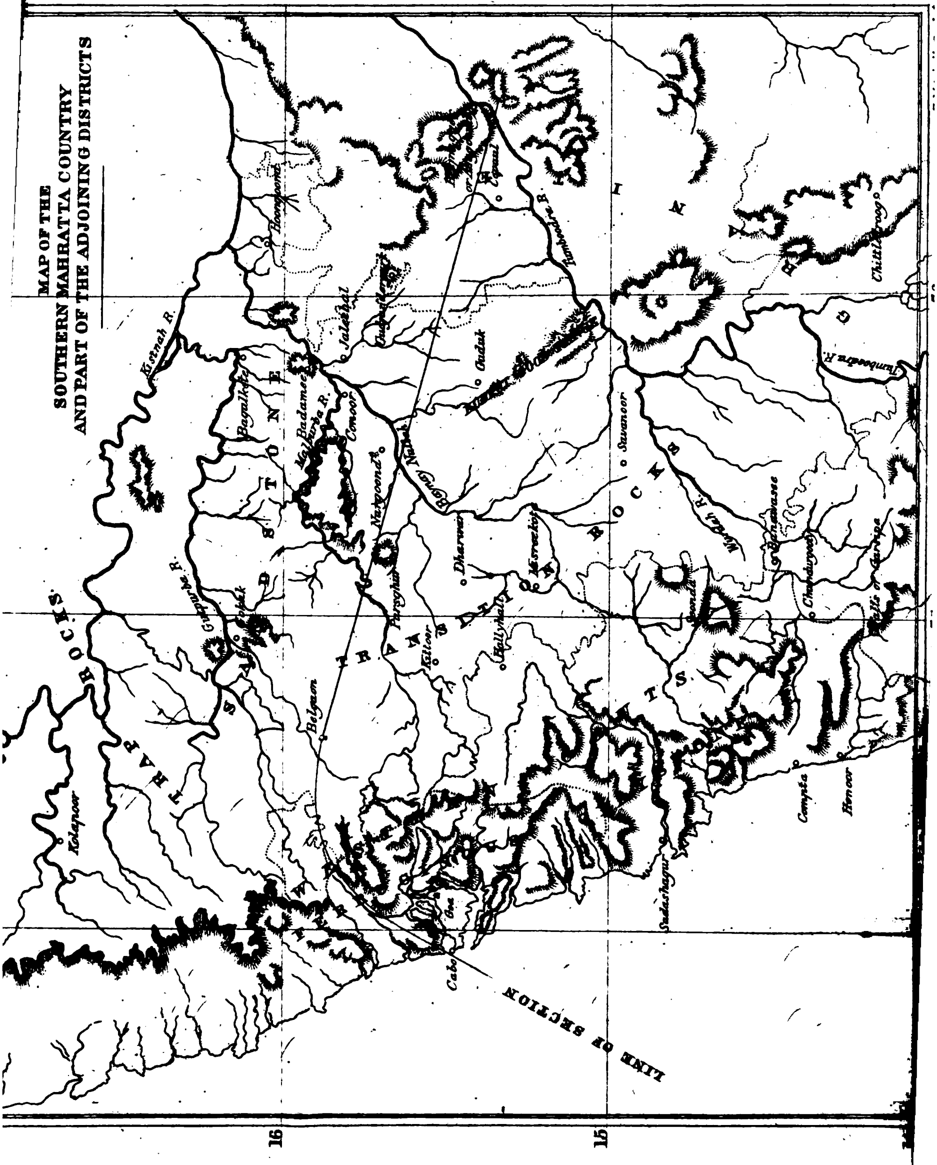MAP OF THE
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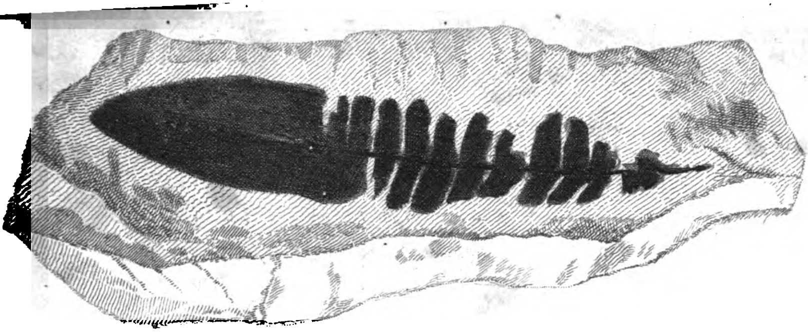
AND PART OF THE ADJOINING DISTRICTS
Kolapoor
Belgaum
Gokak
Ghutpurba R.
Kistnah R.
Bagalkote
Badamee
Malpurba R.
Comoor
Jalehal
Hoonugoond
Nurgoond
Parsghur
Kittoor
Dharwar
Hullyhall
Misreekota
Savanoor
Gudak
Copaul
Tumboodra R.
Chittledroog
Wurdah R.
Bunawasee
Chandurgooty
Soondah
Falls of Gairsope
Compta
Honore
Sadashagur
Goa
Cabo
LINE OF SECTION
GHAT ROCKS
SANDSTONE
TRANSITION ROCKS
GNEISS
16
15



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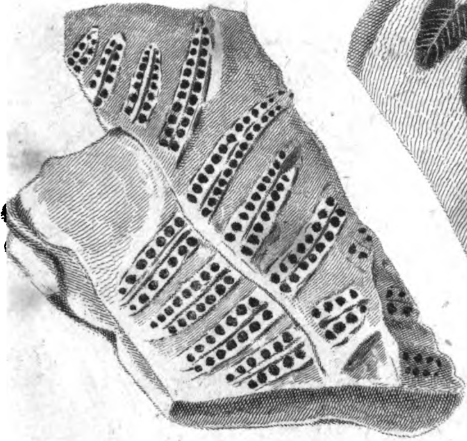

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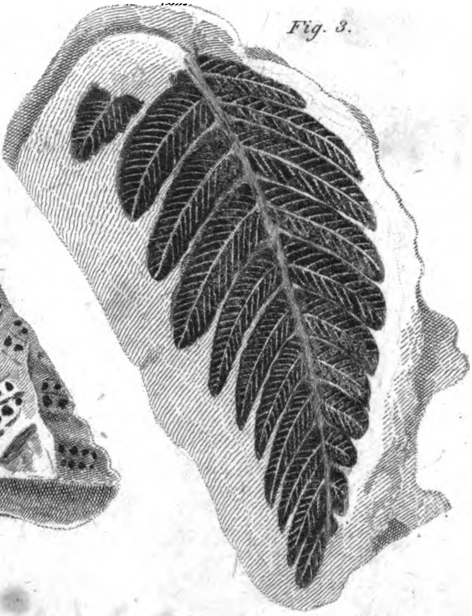

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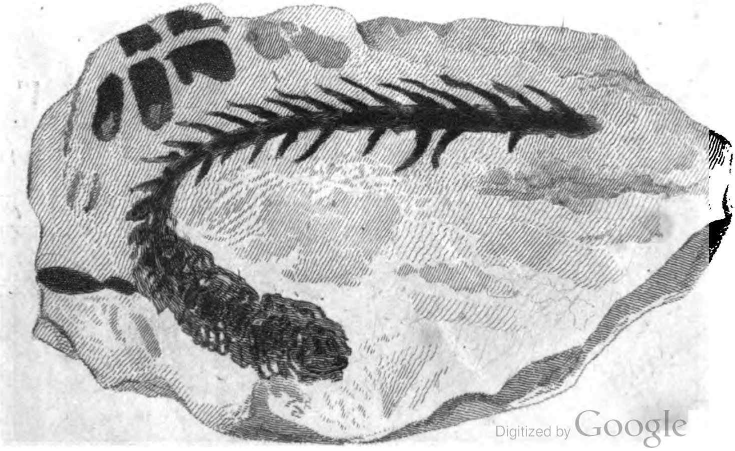

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